Nortel Networks Multiservice Switch

7400/15000/20000

Operations: Trunking

NN10600-420

Nortel Networks Multiservice Switch 7400/15000/20000

Operations: Trunking

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6.1S1 Standard
General availability. Contains information on Nortel Networks Multiservice Switch 7400, 15000, and 20000 for the PCR6.1 release.

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About this document

This guide provides detailed information about using Nortel Networks Multiservice Switch trunks. Multiservice Switch trunks consist of frame-cell trunks and Multiservice Switch trunks over ATM (formerly known as ATM logical trunks). After reading this document, you will have a solid understanding of trunking.

Who should read this document and why

Use this guide if you perform one or more of the following tasks:

- planning a new network or upgrading an existing network
- establishing or testing connections
- reviewing trunking statistics
- technical support for trunking

What you need to know

To understand Nortel Networks Multiservice Switch trunks, and Multiservice Switch trunks over ATM, it is helpful to know about:

- Multiservice Switch software architecture

- Multiservice Switch port management
- Multiservice Switch processor cards (control processors and function processors)
- open systems interconnection (OSI) model
- background knowledge in networking (that is, trunking, routing, and traffic management)
- ATM fundamentals (particularly virtual channel connections as described in NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals*)

What's new in this document

There were no new features added to this document.

Other changes made to this document include the following:

- The terms Passport and PVG have been rebranded in conjunction with the new Nortel Networks' brand simplified naming format. Passport is now referred to as the Nortel Networks Multiservice Switch, and PVG is now Media Gateway 7480/15000. For more information on the product rebranding, refer to NN10600-000 *Nortel Networks Multiservice Switch 7400/15000/20000 What's New in PCR6.1*.
- Changes made throughout the document to enhance compliance with Nortel Networks documentation standards (for example, Modular Task Based Information standards).

Text conventions

This document uses the following text conventions:

- `nonproportional spaced plain type`

  Nonproportional spaced plain type represents system generated text or text that appears on your screen.

- `nonproportional spaced bold type`

  Nonproportional spaced bold type represents words that you should type or that you should select on the screen.

- *italics*

  Statements that appear in italics in a procedure explain the results of a particular step and appear immediately following the step.

  Words that appear in italics in text are for naming.

- [optional_parameter]

  Words in square brackets represent optional parameters. The command can be entered with or without the words in the square brackets.

- <general_term>

  Words in angle brackets represent variables which are to be replaced with specific values.

- UPPERCASE, lowercase

  Nortel Networks Multiservice Switch node commands are not case-sensitive and do not have to match commands and parameters exactly as shown in this document, with the exception of string options values (for example, file and directory names) and string attribute values.

- |

  This symbol separates items from which you may select one; for example, ON|OFF indicates that you may specify ON or OFF. If you do not make a choice, a default ON is assumed.

- ...

  Three dots in a command indicate that the parameter may be repeated more than once in succession.

The term absolute pathname refers to the full specification of a path starting from the root directory. Absolute pathnames always begin with the slash (/) symbol. A relative pathname takes the current directory as its starting point, and starts with any alphanumeric character (other than /).

Related documents

This document features Nortel Networks Multiservice Switch trunking. Introductory and other relevant Multiservice Switch trunking descriptions are in the following documents:

- NN10600-030 *Nortel Networks Multiservice Switch 7400/15000/20000 Overview*
- NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals*
- NN10600-730 *Nortel Networks Multiservice Switch 7400/15000/20000 Inverse Multiplexing for ATM Operations*
- NN10600-060 *Nortel Networks Multiservice Switch 7400/15000/20000 Component Reference*
- NN10600-500 *Nortel Networks Multiservice Switch 6400/7400/15000/ 20000 Alarms Reference*

How to get more help

For information on training, problem reporting, and technical support, see the "Nortel Networks support services" section in the *product overview document.*

Chapter 1
Trunk provisioning and maintenance

Use the tasks listed in this section to provision and maintain trunking services on Nortel Networks Multiservice Switch 7400/15000/20000 nodes.

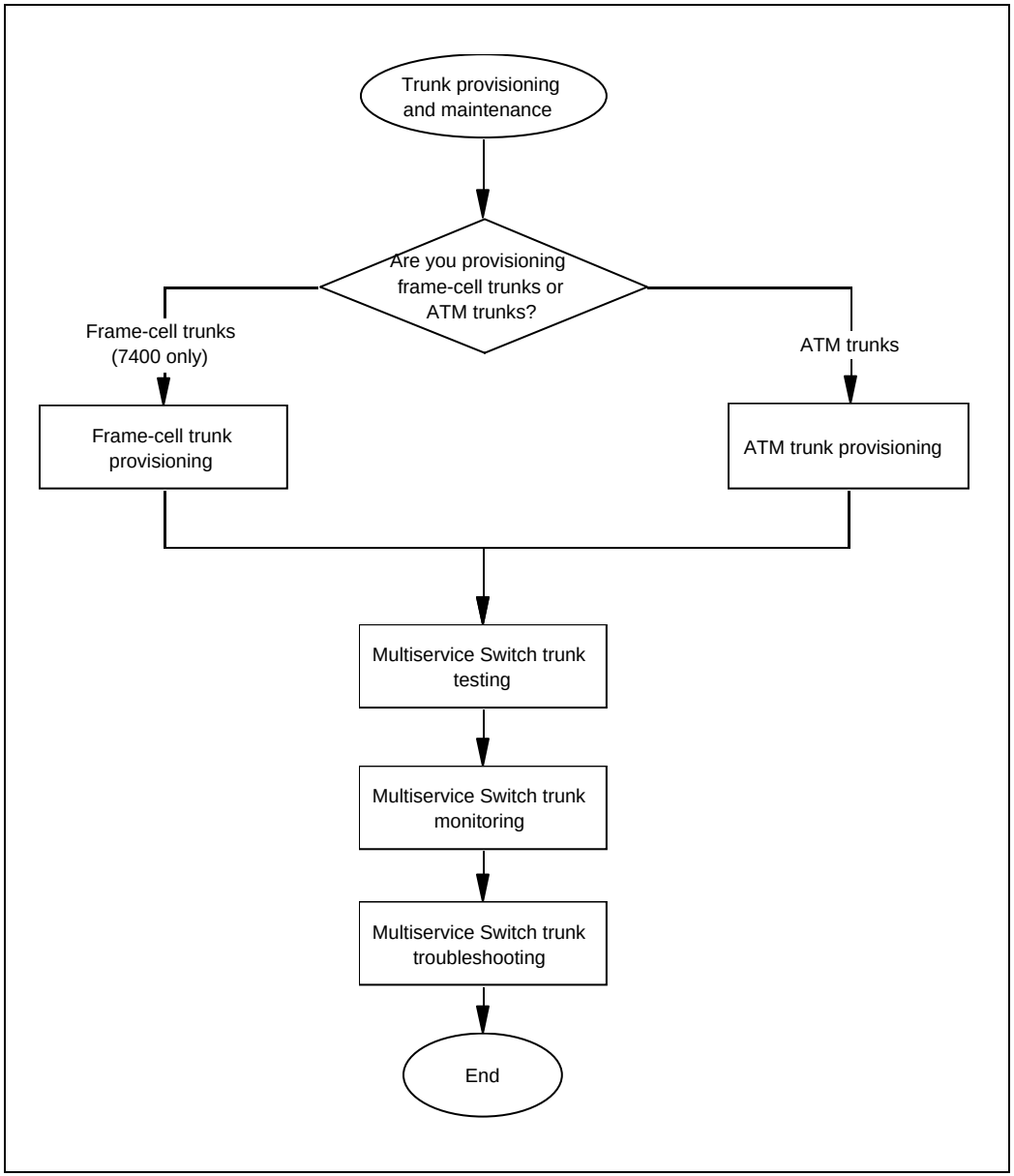
Prerequisites to trunk provisioning and maintenance

- If you are unfamiliar with Nortel Networks Multiservice Switch trunking concepts, see “Understanding Multiservice Switch trunking” (page 99)

Trunk provisioning and maintenance tasks

This work flow shows you the tasks involved in provisioning and maintaining trunking. To link to any procedure, go to “Trunk provisioning and maintenance task navigation” (page 21).

Figure 1
Trunk provisioning and maintenance tasks



Trunk provisioning and maintenance task navigation

Chapter 2
Frame-cell trunk configuration

Configure frame-cell trunking and any associated features to allow node-to-node connections.

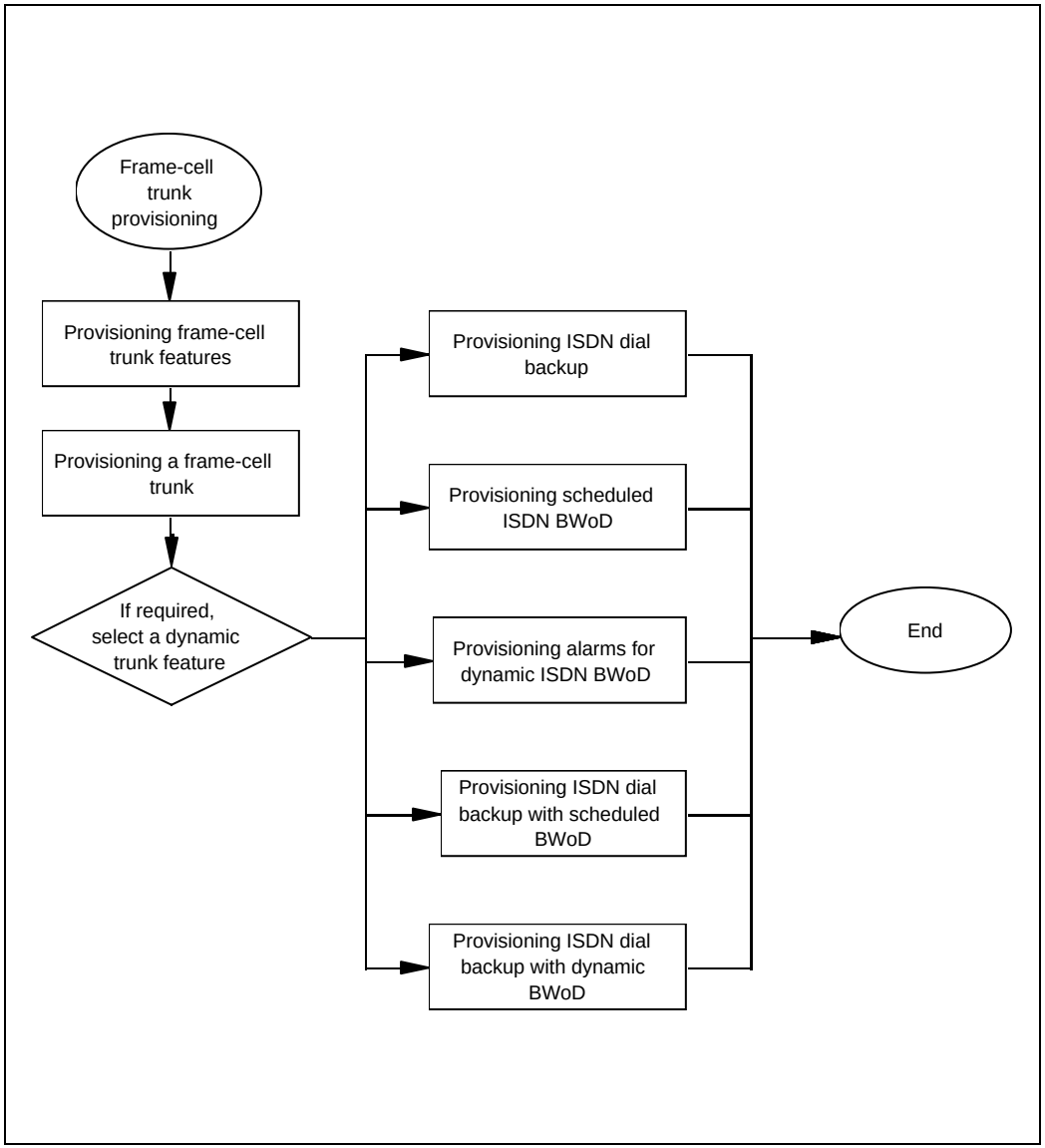
Prerequisites to frame-cell trunk configuration

- If you are unfamiliar with frame-cell trunking or any other aspect of Nortel Networks Multiservice Switch trunking, see “Understanding Multiservice Switch trunking” (page 99) and “Multiservice Switch frame-cell trunks” (page 123)
- Use the “Provisioning worksheet for frame-cell trunks on a Multiservice Switch 7400 node” (page 39) to assist in determining appropriate configuration values.

Frame-cell trunk configuration procedures

This task flow shows you the sequence of procedures you perform to configure frame-cell trunking. To link to any procedure, go to “Frame-cell trunk configuration procedure navigation” (page 25).

Figure 2
Frame-cell trunk configuration procedures



Frame-cell trunk configuration procedure navigation

Configuring frame-cell trunk features

Configure frame-cell trunk features from the logical processor types feature list.

Note: You only need to add PORS trunks to the feature list if voice, video, or other connection-oriented traffic will be transferred over frame-cell trunks.

Prerequisites

- Download the appropriate software from the Software Distribution Site (SDS) (base, trunks, and networking) as described in NN10600-270 *Nortel Networks Multiservice Switch 7400/15000/20000 Software Installation*.
- Configure the logical processors (LPs), function processors (FPs), and ports to be used by the frame-cell trunk feature. For provisioning the hardware components, see NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures* and NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.
- Ensure the network administrator has supplied all of the appropriate provisioning information. This information includes such things as *Trunk* component instance values, and the type of routing used (DPRS or PORS).

  Note: Be aware that when a Nortel Networks Multiservice Switch trunk on a PQC-based FP is connected to another Multiservice Switch trunk that is on a CQC-based FP, then the entire PQC-based FP reverts to software forwarding for dynamic packet routing system (DPRS). This results in a significant performance degradation.

Procedure steps

1. Add the *unackTrunks* component to the application software.

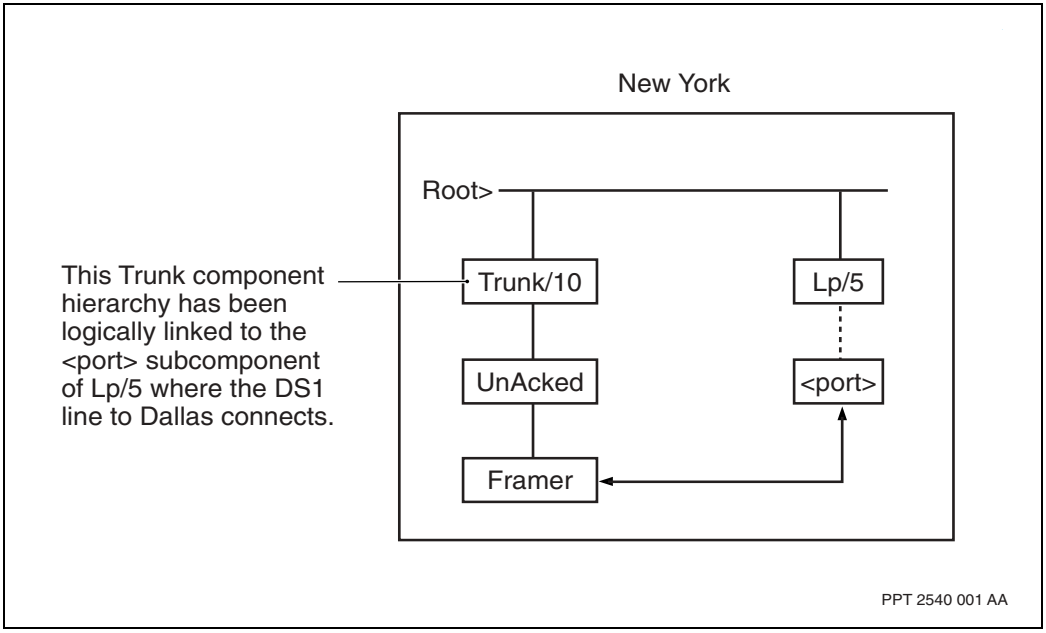
   ```
   add sw lpt/unackTrunk
   ```

2. Use the set command to specify the required features in the logical processor's feature list.

   ```
   set sw lpt/unackTrunk featureList ! unackTrunks
   porsTrunks
   ```

Procedure job aid

Figure 3
Frame-cell trunk component hierarchy



Configuring a frame-cell trunk

Configure a frame-cell trunk using values provided by your network administrator.

Note: The *Trunk* component provides the Multiservice Switch node-to-node connection. You must configure this component on both ends of the connection (on both Multiservice Switch 7400 and Multiservice Switch 15000 nodes).

Prerequisites

- For information on which FPs support Nortel Networks Multiservice Switch trunks, refer to NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.

Procedure steps

1. Add a *Trunk* component.

   ```
   add trunk/<n>
   ```

2. Add an *UnAcked* component.

   ```
   add trunk/<n> unack
   ```

3. Ensure the *Framer* component has the value of the *framingType* attribute set to *interrupting* if a *PathAdmin* (*Pa*) component is provisioned.

4. If you are going to use PORS routing then define the *Pa* component.

   ```
   add trunk/<n> pa
   ```

5. Link the *Framer* component to the required Port or *Channel* component, depending on the type of FP used.

   ```
   set trunk/<n> unack framer interfaceName lp/<p>
   <port>/<m> channel/<c>
   ```

6. Set the framing type.

   ```
   set trunk/<n> unack framer framingType <type>
   ```

7. If you need notification of Multiservice Switch trunk utilization over a provisioned bandwidth threshold, set the trunk utilization alarm threshold mechanism.

   ```
   set trunk/<n> unack framer linkUtilAlarmStatus
   <status>
   ```

8 Provision the minor alarm utilization threshold for each *Trunk UnAcked* component.

```
set trunk/<n> unack framer minorLinkUtilAlarmThreshold
<value1>
```

9 Provision the major alarm utilization threshold for each *Trunk UnAcked* component.

```
set trunk/<n> unack framer majorLinkUtilAlarmThreshold
<value2>
```

10 Provision the critical alarm utilization threshold for each *Trunk UnAcked* component.

```
set trunk/<n> unack framer
criticalLinkUtilAlarmThreshold <value3>
```

Variable definitions

Variable	Value
<c>	is a channel instance
<m>	is the port number
<n>	is the instance value of the *Trunk* component between 0 and 65535
<p>	is the logical processor number
<port>	is the FP type
<status>	is the status of the *linkUtilAlarmStatus* attribute, which can either be enabled or disabled
<type>	is interrupting if the trunk is for a PORS service or DPRS multimedia service, and hdlc for any other type of service
<value1>	is the minor alarm threshold percentage (0% to 100%). An alarm threshold of 100% disables the alarm.
<value2>	is the major alarm threshold percentage (0% to 100%). An alarm threshold of 100% disables the alarm.
<value3>	is the critical alarm threshold percentage (0% to 100%). An alarm threshold of 100% disables the alarm.

Configuring ISDN dial backup

Configure ISDN dial backup by enabling the Nortel Networks Multiservice Switch trunk speed change reporting mechanism for ISDN dial backup applications. The trunk propagates speed variations to the routing systems.

Prerequisites

- If you are unfamiliar with the dynamic speed change feature for Multiservice Switch trunks, see "Dynamic Multiservice Switch trunk speed change for frame-cell trunks" (page 128).

Procedure steps

1. Select a threshold for reporting a speed change.

   ```
   set trunk/<n> speedReportingThresholds
   <expected-speed-of-backup-lines,
   expected-speed-of-leased-line>
   ```

2. Set the period for delaying the speed change report.

   ```
   set trunk/<n> speedReportingHoldOff <seconds>
   ```

   The default value is 30 seconds.

3. If required, set the speed change alarms to indicate when the third-party device is in backup mode.

   ```
   set trunk/<n> lowSpeedAlarmThreshold
   <expected-speed-of-leased-line>
   ```

   ```
   set trunk/<n> highSpeedAlarmThreshold <threshold>
   ```

   If the measured speed decreases below the leased line speed, the low-speed alarm is set. The alarm indicates that the leased line failure has occurred and the third-party device is either in backup mode, or it is dialing up the backup lines. The alarm clears when the measured speed returns to the expected leased line speed. No high-speed alarm is set due to a speed increase.

Variable definitions

Variable	Value
<n>	is the instance value of the *Trunk* component between 0 and 65535
<seconds>	is the value of the *speedReportingHoldOff* attribute (in seconds)
<threshold>	is the maximum value of normal speeds for the trunk. See NN10600-060 *Nortel Networks Multiservice Switch 7400/15000/20000 Component Reference* for the default value.

Configuring scheduled ISDN BWoD

Configure scheduled ISDN BWoD by enabling the Nortel Networks Multiservice Switch trunk speed change reporting mechanism to provision the scheduled ISDN BWoD application (Multiservice Switch 7400 nodes only). The trunk propagates speed variations to the routing systems.

Prerequisites

- If you are unfamiliar with the dynamic speed change feature for Multiservice Switch trunks, see "Dynamic Multiservice Switch trunk speed change for frame-cell trunks" (page 128).

Procedure steps

1. Select a threshold for reporting a speed change.

   set trunk/<n> speedReportingThresholds <expected-speed-of-leased-line, expected-peak-speed>

2. Set the period for delaying the speed change report.

   set trunk/<n> speedReportingHoldOff <seconds>

   The default value is 30 seconds.

3. If required, you can set the speed change alarms to indicate when the third-party device is using the BWoD mode of operation.

   set trunk/<n> highSpeedAlarmThreshold <expected-speed-of-leased-line>

   set trunk/<n> lowSpeedAlarmThreshold <threshold>

   If the measured speed increases above the leased line speed, the high-speed alarm is set indicating that the third-party device is using extra bandwidth. The alarm clears when the measured speed returns to the expected leased line speed. No alarm is set due to a speed decrease.

Variable definitions

Variable	Value
<n>	is the instance value of the *Trunk* component between 0 and 65535
<seconds>	is the value of the *speedReportingHoldOff* attribute (in seconds)
<threshold>	is the value of the *lowSpeedAlarmThreshold* attribute. The default value is zero

Configuring alarms for dynamic ISDN BWoD

Configure alarms for dynamic ISDN BWoD. In the dynamic ISDN BWoD application, the Nortel Networks Multiservice Switch trunk speed change reporting mechanism is disabled. Multiservice Switch trunk speed variations do not propagate to the routing systems. The speed change alarms are necessary to indicate when the third-party device is in the BWoD mode. The feature applies to Multiservice Switch 7400 series nodes only).

Prerequisites

- If you are unfamiliar with the dynamic speed change feature for Multiservice Switch trunks, see "Dynamic Multiservice Switch trunk speed change for frame-cell trunks" (page 128).

Procedure steps

1. If required, you can set the speed change alarms to indicate when the third-party device is using the BWoD mode of operation.

   `set trunk/<n> highSpeedAlarmThreshold <expected-speed-of-leased-line>`

   `set trunk/<n> lowSpeedAlarmThreshold <threshold>`

   If the measured speed increases above the leased line speed, the high-speed alarm indicates that the third-party device is using extra bandwidth. The alarm clears when the measured speed returns to the expected leased line speed. No alarm is set due to a speed decrease.

Variable definitions

Variable	Value
<n>	is the instance value of the *Trunk* component between 0 and 65535
<threshold>	is the value of the *lowSpeedAlarmThreshold* attribute. The default value is zero

Configuring ISDN dial backup with scheduled BWoD

Configure ISDN dial backup with scheduled BWoD. Enable the Nortel Networks Multiservice Switch trunk speed change reporting mechanism to provision ISDN dial backup with scheduled BWoD. The trunk propagates speed variations to the routing systems. This feature is available on Multiservice Switch 7400 series nodes only.

Prerequisites

- If you are unfamiliar with the dynamic speed change feature for Multiservice Switch trunks, see "Dynamic Multiservice Switch trunk speed change for frame-cell trunks" (page 128).

Procedure steps

1 Select a threshold for reporting a speed change.

```
set trunk/<n> speedReportingThresholds
<expected-backup-speed,
expected-speed-of-leased-line, expected-peak-speed>
```

2 Set the period for delaying the speed change report.

```
set trunk/<n> speedReportingHoldOff <seconds>
```

The default value is 30 seconds.

3 If required, set the speed change alarms to indicate when the third-party device is using either the backup or the scheduled BWoD mode of operation.

```
set trunk/<n> lowSpeedAlarmThreshold
<expected-speed-of-leased-line>
```

```
set trunk/<n> highSpeedAlarmThreshold
<expected-speed-of-leased-line>
```

If the measured speed decreases below the leased line speed, the Multiservice Switch trunking system sets the low decrease series trunking system sets the low decrease alarm. The alarm indicates that a leased line failure has occurred and the third-party device is either in backup mode or it is dialing up the backup lines. The alarm clears when the measured speed returns to the expected leased line speed.

If the measured speed increases above the leased line speed, the trunking system sets the high-speed alarm. The alarm indicates that the

third party device is using extra scheduled bandwidth. The alarm clears when the measured speed returns to the expected leased line speed.

Variable definitions

Variable	Value
<expected-speed-of-leased-line>	is the trunk speed reporting threshold values (in seconds)
<n>	is the instance value of the *Trunk* component between 0 and 65535
<seconds>	is the value of the *speedReportingHoldOff* attribute (in seconds)

Configuring ISDN dial backup with dynamic BWoD

Configure ISDN dial backup with dynamic BWoD. In the dial backup application, the Nortel Networks Multiservice Switch trunk speed change reporting mechanism is enabled. The trunk propagates speed variations to the routing systems. In the dynamic BWoD application, the trunk speed change reporting mechanism is disabled. Multiservice Switch trunk speed variations do not propagate to the routing systems. This feature is available on Multiservice Switch 7400 series nodes only.

Prerequisites

- If you are unfamiliar with the dynamic speed change feature for Multiservice Switch trunks, see "Dynamic Multiservice Switch trunk speed change for frame-cell trunks" (page 128).

Procedure steps

1. Select a threshold for reporting a speed change.

   ```
   set trunk/<n> speedReportingThresholds
   <expected-backup-speed,
   expected-speed-of-leased-line>
   ```

2. Set the period for delaying the speed change report.

   ```
   set trunk/<n> speedReportingHoldOff <seconds>
   ```

   The default value is 30 seconds.

3. If required, set the speed change alarms to indicate when the third-party device is using either the backup or the dynamic BWoD mode of operation.

   ```
   set trunk/<n> lowSpeedAlarmThreshold
   <expected-speed-of-leased-line>
   ```

   ```
   set trunk/<n> highSpeedAlarmThreshold
   <expected-speed-of-leased-line>
   ```

   If the measured speed decreases below the leased line speed, the Multiservice Switch trunking system sets the low-speed alarm. The alarm indicates that a leased line failure has occurred and the third-party device is either in backup mode or it is dialing up the backup lines. The alarm clears when the measured speed returns to the expected leased line speed.

If the measured speed increases above the leased line speed, the Multiservice Switch trunking system sets a high-speed alarm. The alarm indicates that the third party device is using extra bandwidth that the third party device dialed up dynamically to accommodate the traffic peaks. The alarm clears when the measured speed returns to the expected leased line speed.

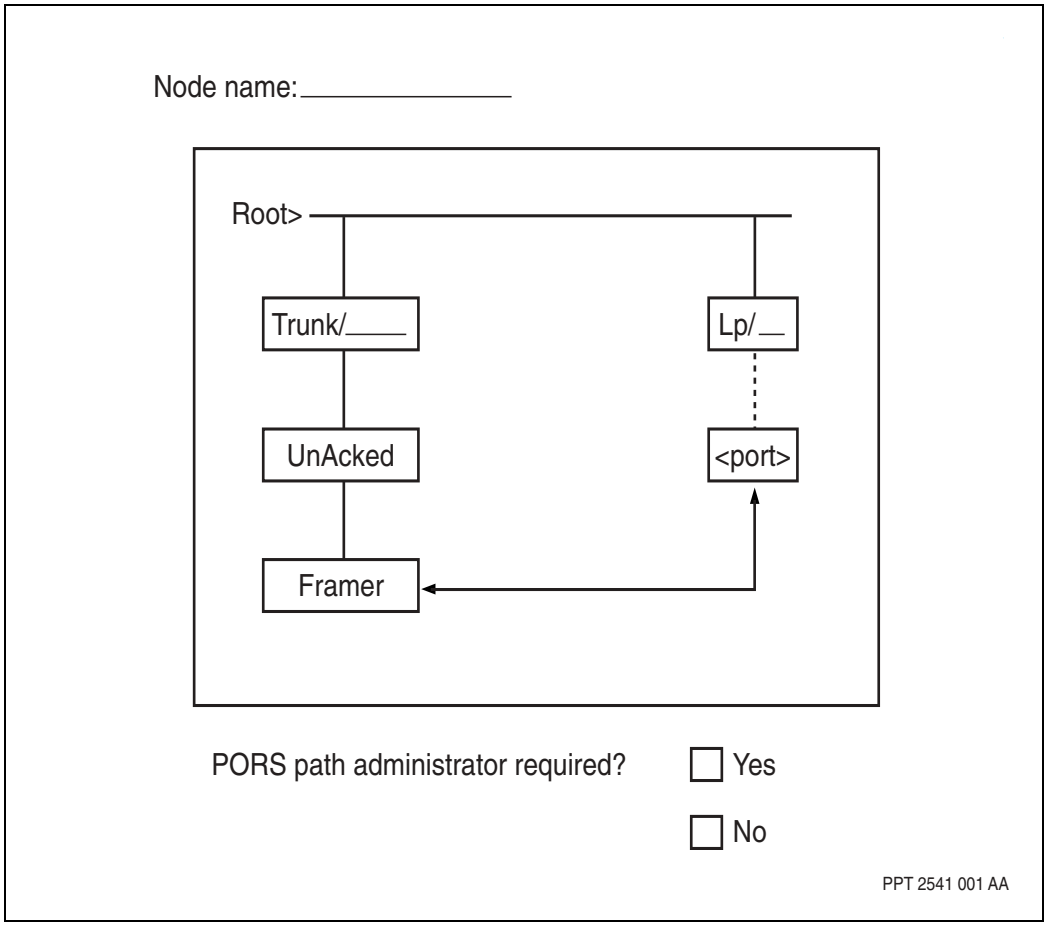
Variable definitions

Variable	Value
<expected-backup-speed, expected-speed-of-leased-line>	is the trunk speed reporting threshold values
<n>	is the instance value of the *Trunk* component between 0 and 65535
<seconds>	is the value of the *speedReportingHoldOff* attribute (in seconds)

Provisioning worksheet for frame-cell trunks on a Multiservice Switch 7400 node

This section provides examples of provisioning frame-cell trunks using the details in “Provisioning worksheet for frame-cell trunks” (page 40). The figure shows a diagram that you can use to record the details for your frame-cell trunk. Make copies of this page and use it. Give the copies to your network administrator to fill in the necessary blanks. These sheets closely match the format and sequence as followed in this guide.

Figure 4
Provisioning worksheet for frame-cell trunks



<port>: The exact *port* subcomponent to which the *Framer* component links depends on the type of function processor. See NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference* for provisioning information on the subcomponent for each FP.

Chapter 3
ATM trunk configuration

Configure ATM trunks to logically interconnect Multiservice Switch nodes over ATM facilities.

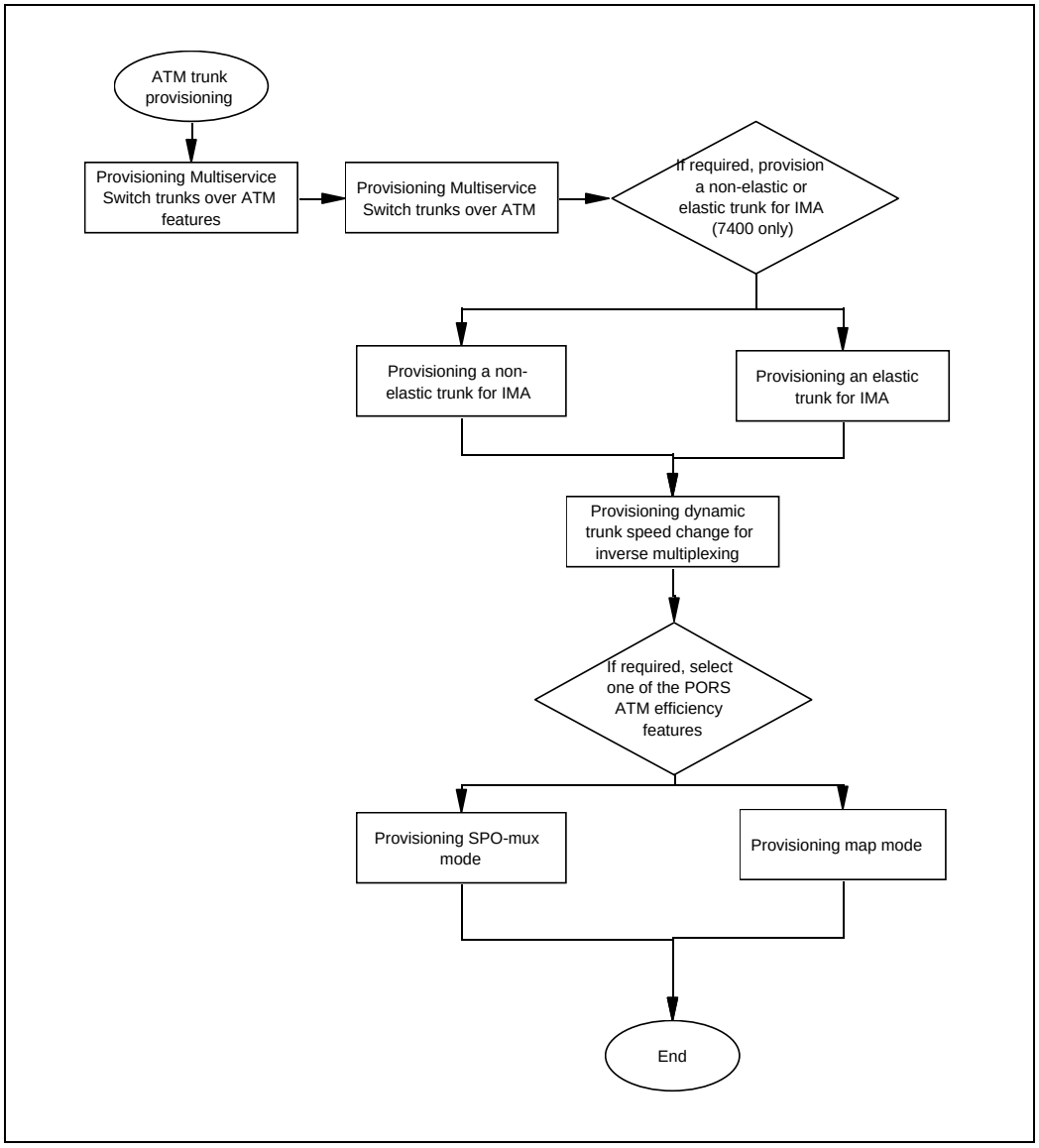
Prerequisites to ATM trunk configuration

- If you are unfamiliar with provisioning ATM trunks concepts, see “Understanding Multiservice Switch trunking” (page 99) and “Multiservice Switch trunks over ATM” (page 137).
- Use the “Provisioning worksheet for Multiservice Switch trunks over ATM” (page 60) to assist in determining appropriate configuration values.

ATM trunk configuration procedures

This task flow shows you the sequence of procedures you perform to provision ATM trunks. To link to any procedure, go to “ATM trunk provisioning procedure navigation” (page 43).

Figure 5
ATM trunk provisioning procedures



ATM trunk provisioning procedure navigation

Provisioning Multiservice Switch trunks over ATM features

Provision Multiservice Switch trunks over ATM features from the logical processor types feature list.

Note: You need PORS trunks in the feature list only if voice, video, or other connection-oriented traffic will use Multiservice Switch trunks over ATM.

Prerequisites

- Ensure the required ATM interface and connection have been properly configured. See NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management* for more information.
- Ensure an Lp/port has been provisioned for the *AtmIf* components used by the Nortel Networks Multiservice Switch trunk feature.
- Ensure the Network Administrator has supplied all of the appropriate provisioning information. This information includes such things as Trunk instance values, and the type of routing used (PORS, connectionless, or both).

Note: Be aware that when a Multiservice Switch trunk on a PQC-based FP is connected to another Multiservice Switch trunk that is on a CQC-based FP, then the entire PQC-based FP reverts to software forwarding for dynamic packet routing system (DPRS). This results in a significant performance degradation. On a PQC12-based FP, it does not revert to software forwarding, but uses hardware forwarding instead; therefore, there is no performance degradation.

Procedure steps

1. Add the *AtmTrunks* component to the application software.

   ```
   add sw lpt/atmtrk
   ```

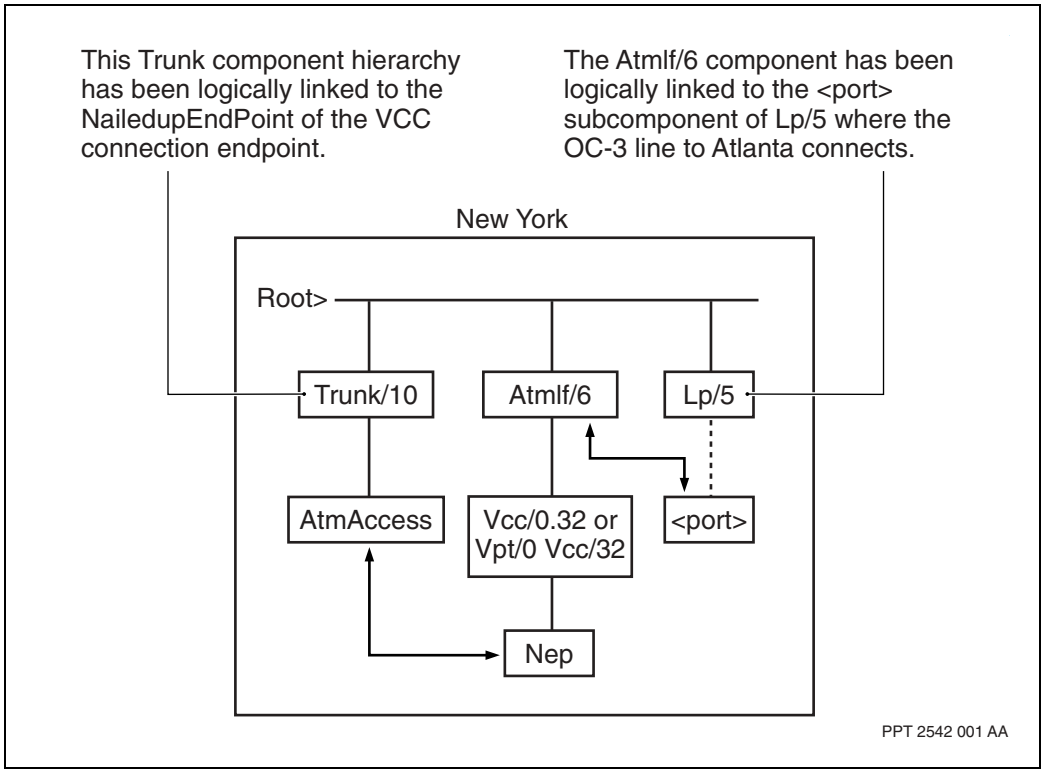
2. Use the set command to specify the required features in the logical processor's feature list.

   ```
   set sw lpt/atmtrk featureList ! atmTrunks porsTrunks
   ```

3. Continue ATM trunk provisioning. See "ATM trunk configuration procedures" (page 41).

Procedure job aid

Figure 6
Multiservice Switch trunks over ATM component hierarchy



Provisioning Multiservice Switch trunks over ATM

Provision Multiservice Switch trunks over ATM using values provided by your network administrator.

Note: The *Trunk* component provides the Multiservice Switch node-to-node connection. This component must be provisioned on both ends of the connection (on both Multiservice Switch nodes).

Procedure steps

1. Add a *Trunk* component.

   ```
   add trunk/<n>
   ```

   The *Trunk* component has default values assigned to its attributes.

2. If required, use the set command to alter the default values for *Trunk* component attributes.

3. Add an *AtmAccess* component.

   ```
   add trunk/<n> atm
   ```

4. If there is not already one configured, configure the ATM connection. The connection can be associated with the interface, or with a virtual path terminator. See 241-5701-710 *Passport 7400, 15000, 20000 ATM Configuration Guide* for details.

5. Use the SET command to alter the values assigned to the *Tm* component to satisfy the requirements of the *atmConnection*.

   ```
   set AtmIf/<m> [Vpt/<Vpi>] Vcc/<x> Vcd Tm
   txTrafficDescType 3
   ```

   ```
   set AtmIf/<m> [Vpt/<Vpi>] Vcc/<x> Vcd Tm
   txTrafficDescParm 1 <PCR>
   ```

   ```
   set AtmIf/<m> [Vpt/<Vpi>] Vcc/<x> Vcd Tm
   atmServiceCategory <service>
   ```

   The following restrictions apply when provisioning Multiservice Switch trunks over ATM:

   - The only permissible value for both rxTrafficDescType attribute and txTrafficDescType is 3.
   - Multiservice Switch trunks over ATM do not support unspecified bit rate (UBR), the default ATM service category on Multiservice Switch nodes.

- For the CBR service category, the txQueueLimit attribute must be at least 88 in order for the trunk to stage.
- For the rt-VBR and nrt-VBR service categories, the txQueueLimit attribute must be set to 0 or at least 88 in order for the trunk to stage (for values between 0 and 88 the trunk will not stage). Also, the minPerVcQueueLimit attribute must be set to at least 88 in order for the trunk to stage.

6 Add the *NailedUpEndPoint* component.

```
add AtmIf/<m> [Vpt/<Vpi>] Vcc/<x> Nep
```

7 Link this application component to the *NailedUpEndPoint* component.

```
set trunk/<n> atmAccess atmConnection AtmIf/<m>
[Vpt/<Vpi>] Vcc/<x> Nep
```

8 If you are going to use PORS routing, add a *PathAdmin* (*Pa*) component.

```
add trunk/<n> pa
```

9 If required, use the SET command to alter the default values for the *PA* component attributes.

10 If you need utilization notification for Multiservice Switch trunks over ATM over a provisioned bandwidth threshold, set the trunks over ATM utilization alarm mechanism and provision the utilization thresholds for each *Trunk ATMAccess* component.

```
set trunk/<n> atm vccUtilAlarmStatus <status>

set trunk/<n> atm minorVccUtilAlarmThreshold <value1>

set trunk/<n> atm majorVccUtilAlarmThreshold <value2>

set trunk/<n> atm criticalVccUtilAlarmThreshold
<value3>
```

When the critical alarm is received by Preside MDM, the trunk is marked as out of service. The trunk itself is still up but if the threshold is set correctly, the trunk is nearing saturation.

CAUTION

Utilization calculation does not account for VCC traffic

The utilization calculation is provided for the AAL5 VCC only. It does not account for the traffic received by VCCs that are managed directly by the *Trunk PA* component. Traffic on the companion VCCs in SPO-mux mode and map mode trunks is not considered by the utilization alarm. As a result, the alarm threshold must be set according to the amount of DPRS and PORS AAL5-mux traffic that the link is likely to carry.

11 Continue ATM trunk provisioning. See "ATM trunk configuration procedures" (page 41).

Variable definitions

Variable	Value
<m>	*AtmIf* component instance value
<n>	instance value of the *Trunk* component between 0 and 65535
<status>	enabled or disabled
<value1>	minor alarm threshold percentage (0% to 200%). An alarm threshold of 200% disables the alarm threshold.
<value2>	major alarm threshold percentage (0% to 200%). An alarm threshold of 200% disables the alarm threshold.
<value3>	critical alarm threshold percentage (0% to 200%). An alarm threshold of 200% disables the alarm threshold.
<Vpi>	defines the instance of the *Vpt* component
[Vpt/<Vpi>]	*VirtualPathTerminator* component. Use this parameter if you are associating the virtual connection with a virtual path terminator.
<x>	instance of the *Vcc* component. If the virtual channel is associated with an *AtmIf* component, <x> represents the VPI.VCI value. If the virtual channel is associated with a *Vpt* component, <x> represents VCI value.

Provisioning a non-elastic trunk for IMA

Provision a non-elastic trunk for IMA. The trunk will either be up with its full committed bandwidth, or down. When the IMA link group capacity drops, some non-elastic connections in an ATM interface must be released according to the connection bandwidth control (CBC) algorithm. The order in which the non-elastic trunks release is based on their holding priority relative to other non-elastic connections. The trunk speed change reporting mechanism is disabled for non-elastic trunks. This feature is available for Nortel Networks Multiservice Switch 7400 series nodes only.

Procedure steps

1. Set up the Nortel Networks Multiservice Switch trunk over ATM as non-elastic.

   `set trunk/<n> atmAccess bwElastic no`

2. Disable the trunk speed change reporting mechanism by clearing the list of thresholds.

   `set trunk/<n> speedReportingThresholds`

3. Continue ATM trunk provisioning. See “ATM trunk configuration procedures” (page 41).

Variable definitions

Variable	Value
<n>	instance value of the *Trunk* component between 0 and 65535

Provisioning an elastic trunk for IMA

Provision an elastic trunk for IMA where the ATM software admits a bandwidth elastic trunk regardless of the bandwidth available. If the bandwidth is available, the ATM software admits an elastic trunk at full bandwidth. If only part of the requested bandwidth is available, or if other elastic trunks must be reduced to make room for it, the ATM software admits the elastic trunk at reduced bandwidth. The ATM software does not release an elastic trunk if the bandwidth available to the trunk is reduced. The elastic trunks allocated bandwidth is subject to change according to the connection bandwidth control (CBC) algorithm when the link group capacity fluctuates.

This feature is available for Nortel Networks Multiservice Switch 7400 series nodes only.

Procedure steps

1. Set up the *Trunk AtmAccess* component over IMA as elastic.

   ```
   set trunk/<n> atmAccess bwElastic yes
   ```

2. Set the threshold (in bit/s) for reporting the speed change.

   ```
   set trunk/<n> speedReportingThresholds <level1,
   level2, level3, expected-normal-bandwidth>
   ```

3. Set the period for delaying the speed change report.

   ```
   set trunk/<n> speedReportingHoldOff <seconds>
   ```

   If the measured speed decreases below the expected normal bandwidth, which can be the same as the PCR, the low speed alarm indicates a facility problem. The alarm clears when the measured speed returns to the expected normal speed.

4. If required, set the speed change alarms to indicate when the FP experiences facility problems.

   ```
   set trunk/<n> lowSpeedAlarmThreshold <expected-normal-
   bandwidth>
   ```

   ```
   set trunk/<n> highSpeedAlarmThreshold <threshold>
   ```

   No high-speed alarm is set due to a speed increase.

5. Continue ATM trunk provisioning. See “ATM trunk configuration procedures” (page 41).

Variable definitions

Variable	Value
<n>	instance value of the *Trunk* component between 0 and 65535
<seconds>	period of time. The default value is 30 seconds.
<threshold>	maximum value of normal speeds for the trunk (in bit/s). See NN10600-060 *Nortel Networks Multiservice Switch 7400/15000/20000 Component Reference* for the default value.

Provisioning dynamic trunk speed change inverse multiplexing

Provision dynamic trunk speed change inverse multiplexing by setting the Trunk *speedReportingThresholds* attribute. There is no default value but an empty value disables the mechanism. In the inverse multiplexing application, the trunk speed change reporting mechanism is enabled. Nortel Networks Multiservice Switch trunk speed variations are propagated to the routing systems.

This feature is available on Nortel Networks Multiservice Switch 7400 series nodes only.

Prerequisites

- If you are unfamiliar with the concepts relating to dynamic trunk speed change, see "Dynamic trunk speed change on Multiservice Switch trunks over ATM" (page 150).

Procedure steps

1. Provision the trunk according to "Provisioning Multiservice Switch trunks over ATM" (page 46).
2. Set the threshold for reporting the speed change.

   ```
   set trunk/<n> speedReportingThresholds
   <level1, level2, level3, ... level6,
   expected-normal-bandwidth>
   ```

3. Set the period for delaying the speed change report.

   ```
   set trunk/<n> speedReportingHoldOff <seconds>
   ```

4. If required, you can set the speed change alarms can be set to indicate when the third-party device experiences facility problems.

   ```
   set trunk/<n> lowSpeedAlarmThreshold
   <expected-normal-bandwidth>
   ```

   ```
   set trunk/<n> highSpeedAlarmThreshold <threshold>
   ```

   If the measured speed decreases below the expected normal bandwidth, the low-speed alarm is set indicating a facility problem. The alarm clears when the measured speed returns to the expected normal speed. No high-speed alarm is set due to a speed increase.

5 Continue ATM trunk provisioning. See “ATM trunk configuration procedures” (page 41).

Variable definitions

Variable	Value
<level1, level2, level3, ... expected-normal-bandwidth>	thresholds at which the trunk should report speed increases to the routing system (in bit/s). You should set expected-normal-bandwidth to the expected normal bandwidth for the trunk. Optionally, you can define up to six additional thresholds (<level1, level2, ...>) to control speed increase reporting at both lower and higher bandwidth allocation values.
<n>	instance value of the *Trunk* component between 0 and 65535
<seconds>	period of time. The default value is 30 seconds.
<threshold>	maximum value of normal speeds for the trunk. See NN10600-060 *Nortel Networks Multiservice Switch 7400/15000/20000 Component Reference* for the default value.

Provisioning the SPO-mux mode

Provision the SPO-mux mode to take advantage of ATM efficiency on a Nortel Networks Multiservice Switch trunk over ATM. You can enable the SPO-mux mode transport capability by provisioning a new *Trunk* subcomponent and linking this subcomponent to a new VCC.

Note: To activate the PORS ATM efficiency feature you must provision both ends of the VCC.

Prerequisites

- You must have configured the required ATM interfaces and connections on the node before preforming this procedure. An ATM connection can be associated with and *AtmIf* or a *Vpt* component. For more information about ATM provisioning, see NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management*.

Procedure steps

1. Configure the ATM interface and ATM connections as detailed in NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management*.
2. Provision a new VCC to run voice or BTDS packet traffic.

   ```
   add AtmIf/10 Vcc/<vcc>
   ```

   If the VCC is associated with a virtual path terminator, the VPI value is the instance of the Vpt component. The VCI value is the instance of the Vcc component.
3. Add a *NailedUpEndPoint* (*Nep*) component under the Vcc connection.

   ```
   add AtmIf/10 Vcc/<vcc> Nep
   ```
4. Set the *endToEndLoopback* attribute.

   ```
   set AtmIf/10 Vcc/<vcc> Vcd endToEndLoopback on
   ```

   The default value for the *endToEndLoopback* attribute is off. In this case, loopback is on since it provides a software continuity check. The check ensures that the VCC that is linked to the *Pa* component connects to its proper destination.
5. Set the type of traffic management for the transmit direction of the connection.

set AtmIf/10 Vcc/<vcc> Vcd Tm txTrafficDescType <txTdt>

set AtmIf/10 Vcc/<vcc> Vcd Tm txTrafficDescParm <txTdp>

When <txTdt> is 1 (the default value), do not provision any traffic descriptor parameters.

When <txTdt> is 3, use parameter 1 of <txTdp> to specify peak cell rate (PCR) in cells/s for cell loss priority (CLP) 0 traffic and CLP1 traffic.

When <txTdt> is 6, use parameter 1 of <txTdp> to specify PCR in cells/s for CLP0 traffic and CLP1 traffic. Use parameter 2 of <txTdp> to specify sustained cell rate (SCR) in cells/s for CLP0 and CLP1 traffic. Use parameter 3 of <txTdp> to specify maximum burst size in cells.

6 Provision the *Trunk AtmAccess* component and attributes as outlined in Figure 6, "Provisioning Multiservice Switch trunks over ATM," (page 46).

7 Add a *Pa* component.

add trk/10 pa

8 Use the Set command to change *Pa* component values from the default, if necessary.

9 Add the *AtmAccess* component.

add trk/10 pa atm

10 Make sure that you have fully provisioned Vcc/<vcc>.

11 Link the *atmConnection* attribute to the *NailedUpEndPoint* component.

set TRK/10 pa ATM atmConnection AtmIf/10 Vcc/0.35 nep

Variable definitions

Variable	Value
<txTdp>	a vector of five parameters. For PORS ATM efficiency, you can set one or three of the parameters.
<txTdt>	can be 1, 3, or 6. The default value is 1.
<vcc>	value of the Vcc instance

Procedure job aid

Figure 7
ATM cell efficiency component hierarchy with sample links

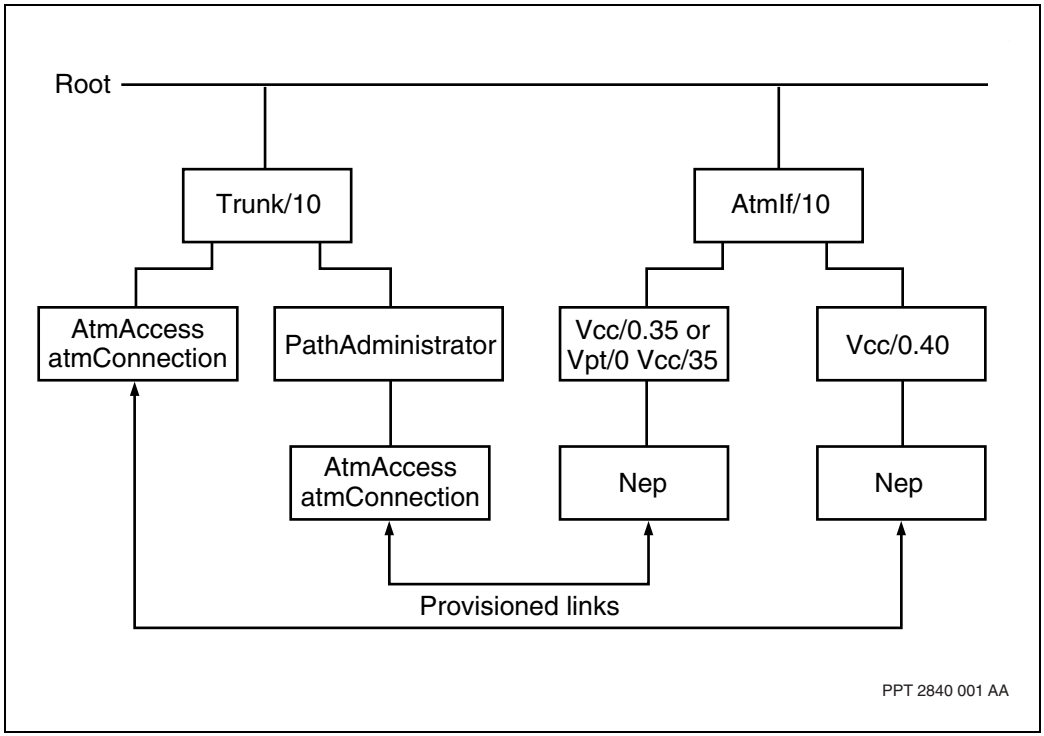


Figure 7, "ATM cell efficiency component hierarchy with sample links," (page 56) illustrates the component hierarchy for the PORS ATM efficiency capability. In this figure, one Nortel Networks Multiservice Switch trunk over ATM is set up with two separate VCCs. One VCC is for voice or BTDS packet traffic and the other is for the rest of the traffic types. Other traffic types consist of frame relay, HTDS, and control traffic. To set up a VCC to carry these other traffic types you must set up direct AAL5 connections. You can do this by setting the *AtmConnection* attribute under the *AtmAccess* component and linking this to a specific VCC. In the example in Figure 7, "ATM cell efficiency component hierarchy with sample links," (page 56), it is linked to AtmIf/10 Vcc/0.40. To set up a VCC to carry only voice or BTDS packet traffic, set the *AtmConnection* attribute under the *AtmAccess* component which is located under the *pathAdministrator* component. Next,

link these trunk attributes to a specific VCC. In the Multiservice Switch node-to-node connection example in Figure 7, “ATM cell efficiency component hierarchy with sample links,” (page 56), it is linked to AtmIf/10 Vcc/0.35. You must repeat the provisioning steps in this procedure on both ends of the VCC to activate the ATM cell efficiency capability.

Provisioning map mode

Provision map mode if you want to map the calls to their own VCCs. You must set the *Pa AtmAccess mode* attribute to a value of map at both ends of the link.

Prerequisites

- See NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management*.

Procedure steps

1. Provision the *AtmIf* component and its attributes as outlined in NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management*.
2. Provision the *Trunk AtmAccess* component and attributes as outlined in “Provisioning Multiservice Switch trunks over ATM” (page 46).
3. Add a *Pa* component.

   ```
   add trk/10 pa
   ```

4. Use the Set command to change *Pa* component values from the default, if necessary.

   The difference between the *maxAutoSelectedVciForVpiZero* attribute and the *minAutoSelectedVciForVpiZero* attribute + 1, represents the maximum number of available dynamic VCCs. The value of the *Trunk Pa maxLc* attribute + 10 (the extra headroom provides for bumping and reduces clashing) must be less than this maximum number of dynamic VCCs. If not, the system raises an alarm 7018 0012, and disables map mode. The VCI range is calculated in the same way for non-zero virtual paths: the *AtmIf CA maxAutoSelectedVciForNonZeroVpi* attribute replaces the *maxAutoSelectedVciForVpiZero* attribute and the *AtmIf CA minAutoSelectedVciForNonZeroVpi* attribute replaces the *minAutoSelectedVciFor VpiZero* attribute. If you get an alarm, increase the *maxAutoSelectedVciForVpiZero* attribute under the CA component. On CQC cards, the value for the *maxAutoSelectedVciForVpiZero* attribute must not exceed the number of VCCs allowed under the *conmap* component. If you wish to increase the *maxAutoSelectedVciForVpiZero* attribute, you may have to first increase the ranges in the *connmap component*.
5. Add the *AtmAccess* component.

   ```
   add trk/10 pa atm
   ```

6 Make sure that you have fully provisioned Vcc/0.35.

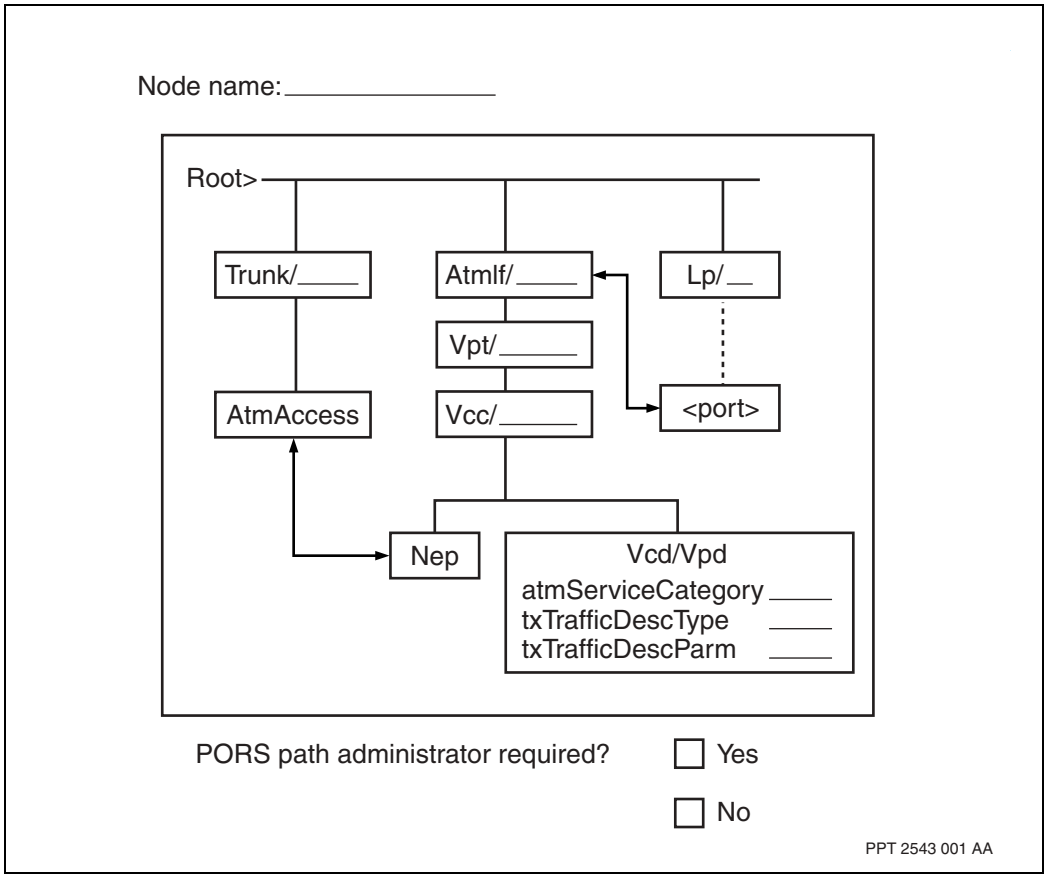
7 Set the *mode* attribute.

```
set trk/10 pa atm mode map
```

Provisioning worksheet for Multiservice Switch trunks over ATM

This section provides examples of provisioning Nortel Networks Multiservice Switch trunks over ATM using the details in Figure 8, "Provisioning worksheet for Multiservice Switch trunks over ATM," (page 60). The figure shows a diagram that you can use to record the details for your trunk over ATM. Make copies of this page and use it. Give the copies to your network administrator to fill in the necessary blanks. These sheets closely match the format and sequence as followed in this guide.

Figure 8
Provisioning worksheet for Multiservice Switch trunks over ATM



The exact *Port* subcomponent to which the *AtmIf* component links depends on the type of ATM function processor. See NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference* for provisioning information on the subcomponent for each FP.

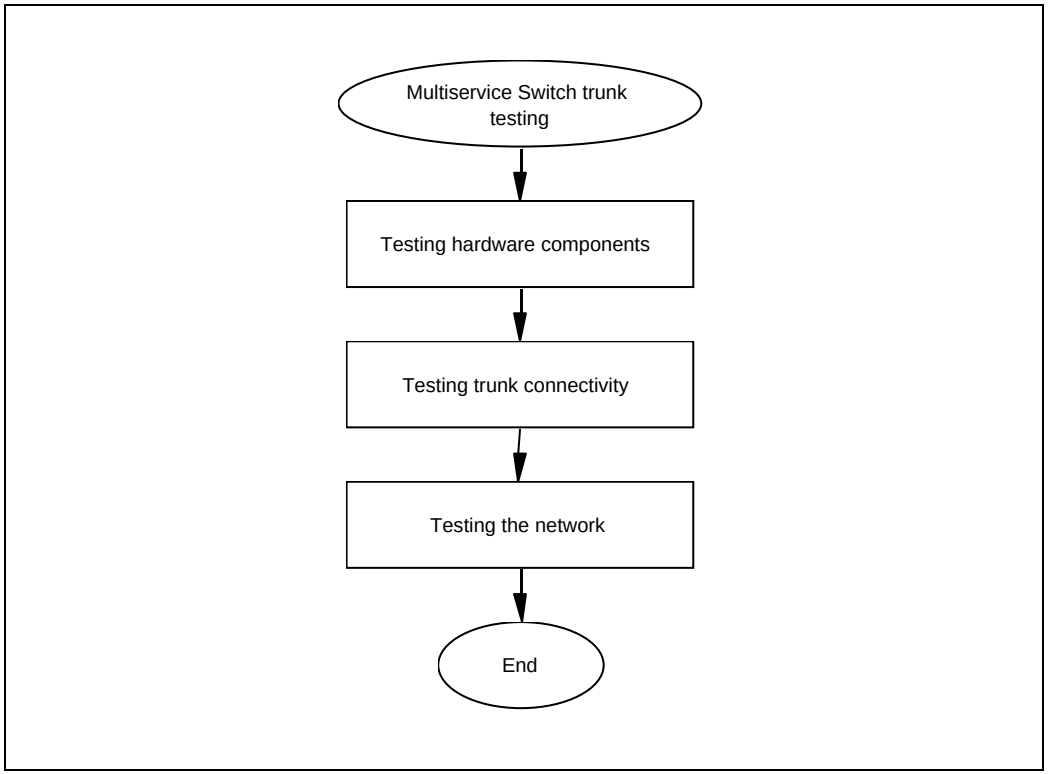
Chapter 4
Multiservice Switch trunk testing

Test Nortel Networks Multiservice Switch trunks to determine whether connections are provisioned and operating within expected parameters.

Multiservice Switch trunk testing procedures

This task flow shows you the sequence of procedures you perform to test Nortel Networks Multiservice Switch trunks. To link to any procedure, go to “Multiservice Switch trunk testing procedure navigation” (page 64).

Figure 9
Multiservice Switch trunk testing procedures



Multiservice Switch trunk testing procedure navigation

- "Testing hardware components" (page 65)
- "Testing trunk connectivity" (page 66)
- "Testing the network" (page 67)

Testing hardware components

Test hardware components as the first step in commissioning a Nortel Networks Multiservice Switch trunk. Use the test subcomponent functionality to determine the sanity of the physical portion of the connection.

For information on performing port tests, see NN10600-520 *Nortel Networks Multiservice Switch 7400/15000/20000 Fault and Performance Management: Troubleshooting*.

> ***Note:*** You must lock Multiservice Switch trunks before performing port tests. For more information on trunk disabling, see "Disabling a trunk" (page 72).

For information on performing line tests, see of NN10600-520 *Nortel Networks Multiservice Switch 7400/15000/20000 Fault and Performance Management: Troubleshooting*.

Once you have performed necessary port and line tests, continue Multiservice Switch trunk testing. See "Multiservice Switch trunk testing procedures" (page 63).

Testing trunk connectivity

Test trunk connectivity once the port and line tests are successful. Each Nortel Networks Multiservice Switch trunk expects to connect to a known port of a known node. This procedure tests the logical connection associated with a Multiservice Switch trunk.

Procedure steps

1. Provision the Multiservice Switch trunk at each end of the connection.
2. Set up each trunk to alarm.

   `set trunk/<n> expectedRemoteNodeName <nodeName>`
3. Disable the trunk if the node does not provide a connection to the other node.

   `set trunk/<n> remoteValidationAction disable`
4. If the trunk does not stage and does not issue an alarm indicating wrong remote then go to “Determining why a frame-cell trunk is not providing service” (page 88).
5. When the trunk stages successfully, verify the node is connected to the expected remote trunk node with the expected facility speed and delay.

   `display trunk/<n> remoteComponentName`

   `display trunk/<n> transport`
6. Examine the trunk statistics to verify connection quality.

   `display trunk/<n> statistics`
7. Continue Multiservice Switch trunk testing. See “Multiservice Switch trunk testing procedures” (page 63).

Variable definitions

Variable	Value
<n>	instance number of the Multiservice Switch trunk between 0 and 65535
<nodeName>	remote node name

Testing the network

Test the network once the Nortel Networks Multiservice Switch trunk test is successful, in order to verify the network connection. The routing system needs to know about each trunk connection and exchange routing information with its counterpart on the remote node. This procedure tests the Multiservice Switch node-to-node connection associated with a Multiservice Switch trunk.

Procedure steps

1. Verify that the transport resource manager (TRM) knows about the Multiservice Switch trunk and reflects the same operational attributes shown by the trunk node.

   ```
   display trm lk/*
   ```

2. Verify that the TRM knows about the node to which the trunk node connects, and reflects the same operational attributes as shown by the trunk node.

   ```
   display trm lg/<nodeName>
   ```

3. Verify that the topology knows about the node to which the trunk node connects, and reflects the same operational attributes as shown by the trunk node.

   ```
   display rtg top node/<nodeName>
   ```

   ```
   display rtg top node/<nodeName> lg/*
   ```

4. Repeat these steps on the remote node.

Variable definitions

Variable	Value
<nodeName>	node name

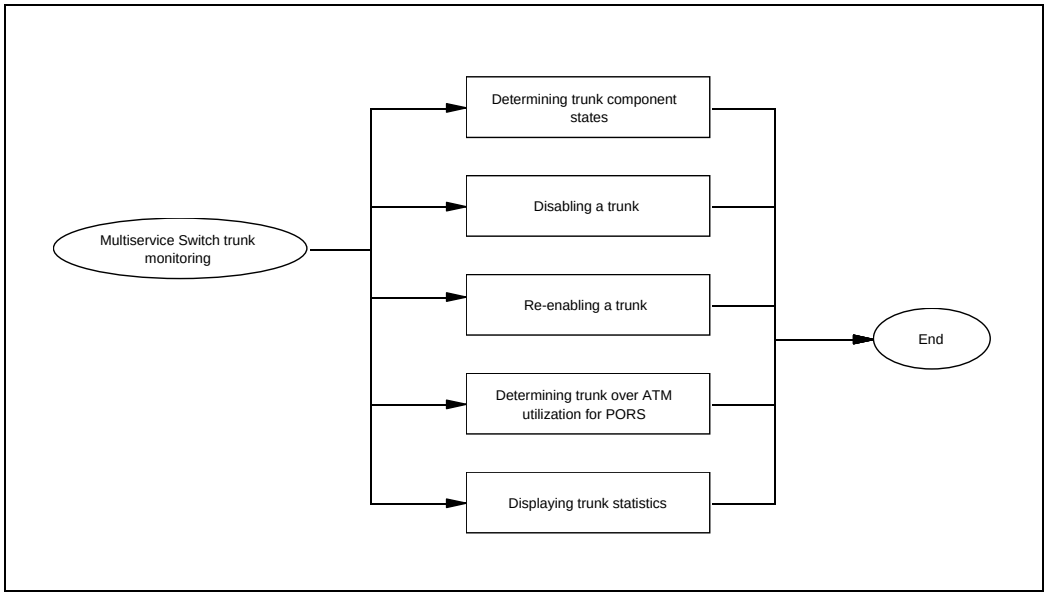
Chapter 5
Multiservice Switch trunk monitoring

Gather information on the condition of Nortel Networks Multiservice Switch trunks to monitor trunk status and performance.

Multiservice Switch trunk monitoring procedures

This task flow shows you the sequence of procedures you perform to monitor Multiservice Switch trunks. To link to any procedure, go to “Multiservice Switch trunk monitoring procedure navigation” (page 70).

Figure 10
Multiservice Switch trunk monitoring procedures



Multiservice Switch trunk monitoring procedure navigation

- “Determining trunk component states” (page 71)
- “Disabling a trunk” (page 72)
- “Re-enabling a trunk” (page 75)
- “Determining trunk over ATM utilization for PORS” (page 76)
- “Displaying trunk statistics” (page 77)

Determining trunk component states

Determine trunk component states for all the trunks on a Nortel Networks Multiservice Switch node.

Prerequisites

- To detect any problems, you must understand how to interpret OSI model state attributes, such as *usageState*, *operationalState* and *adminState*.
- For information about OSI states for Multiservice Switch trunks, see "OSI states for Multiservice Switch trunks" (page 110).
- For more information on OSI model states in general, see NN10600-500 *Nortel Networks Multiservice Switch 6400/7400/15000/20000 Alarms Reference*.

Procedure steps

1 Display the state and status of each operational trunk on the Multiservice Switch node using the following command.

```
display trunk/* osi
```

The system displays information for each operational trunk on the node:

```
Trk/<n>
  adminState =
  operationalState =
  usageState =
  availabilityStatus =
  proceduralStatus =
  controlStatus =
  alarmStatus =
  standbyStatus =
  unknownStatus =
```

A Multiservice Switch trunk is fully operational if the OSI model states in the displayed list appear as

```
  adminState = unlocked
  operationalState = enabled
  usageState = busy
```

If any other state indicators appear, then the trunk is not fully operational.

Disabling a trunk

Disable a trunk in order to perform diagnostics or to remove a trunk from service. The following procedure explains how to lock *Trunk* components. The -forever option locks the Nortel Networks Multiservice Switch trunk indefinitely rather than just for five minutes. The -force option forces the channels down rather than waiting.

CAUTION
Risk of node isolation
Locking a trunk forever can result in node isolation.

Prerequisites

- For information about operational disabling of trunks, see "Operational disabling of Multiservice Switch trunks" (page 113).
- For information about restaging, see "The Multiservice Switch trunk restaging mechanism" (page 114).

Procedure steps

1 Lock the trunk.

```
lock trunk/<n>
```

This command sets the trunk to the OSI model administrative locked state, disabling the trunk for five minutes. Next, the trunk returns to the OSI model unlocked state and attempts to restage with the remote network element. If the trunk is supporting *LogicalChannel* subcomponents, it enters the OSI model administrative ShuttingDown state and waits for all of these channels to go away before it starts the disabling sequence. You can issue an unlock command during this time, returning the trunk to the unlocked state so that it can continue to provide service.

2 Force a lock on the trunk.

```
lock -force trunk/<n>
```

This command sets the trunk to the OSI model administrative locked state, disabling the trunk for five minutes. Next, the trunk returns to the OSI model unlocked state and attempts to restage with the remote

network element. If the trunk is supporting *LogicalChannel* subcomponents, it enters the OSI model administrative ShuttingDown state and forces all of these channels to go away before it starts the disabling sequence. You can issue an unlock command during this time, returning the trunk to the unlocked state so that it can continue to provide service. Only LogicalChannels not yet disabled continue to provide service.

3 Lock the trunk indefinitely.

```
lock -forever trunk/<n>
```

This command sets the trunk to the OSI model administrative locked state, disabling the trunk indefinitely. An unlock command is necessary to put the trunk in the OSI model unlocked state for an attempt to restage with the remote network element. If the trunk is supporting *LogicalChannel* subcomponents, it enters the OSI model administrative ShuttingDown state and waits for all of these channels to go away before it starts the disabling sequence. You can issue an unlock command during this time, returning the trunk to the unlocked state so that it can continue to provide service.

CAUTION

Lock-forever command may isolate the node

Use the lock -forever command carefully to avoid isolating a node.

4 Force a lock on the trunk indefinitely.

```
lock -force -forever trunk/<n>
```

This command sets the trunk to the OSI model administrative locked state, disabling the trunk indefinitely. An unlock command is necessary to put the trunk in the OSI model unlocked state for an attempt to restage with the remote network element. If the trunk is supporting *LogicalChannel* subcomponents, it enters the OSI model administrative ShuttingDown state and forces all of these channels to go away before it starts the disabling sequence. You can issue an unlock command during this time, returning the trunk to the unlocked state so that it can continue to provide service. Only LogicalChannels not yet disabled continue to provide service.

Variable definitions

Variable	Value
<n>	instance number of the Multiservice Switch trunk between 0 and 65535

Re-enabling a trunk

Re-enable a trunk that has been disabled due to a lock -forever or lock -force -forever command.

Note: If a Multiservice Switch trunk has been disabled with a lock or lock -force command, it will re-enable itself within five minutes of being locked.

Prerequisites

- For information about operational disabling of trunks, see "Operational disabling of Multiservice Switch trunks" (page 113).
- For information about restaging, see "The Multiservice Switch trunk restaging mechanism" (page 114).

Procedure steps

1 Unlock the trunk.

```
unlock trunk/<n>
```

CAUTION
Unlocking trunk may cause restaging
Issuing this command results in the trunk attempting to restage.

Variable definitions

Variable	Value
<n>	instance number of the Multiservice Switch trunk between 0 and 65535

Determining trunk over ATM utilization for PORS

Determine trunk over ATM utilization for PORS when you need to provision a single VCC for the *PathAdmin* (*Pa*) component running in mux mode. The *Trunk* component statistics include all statistics.

The system dynamically allocates VCCs at run time for the *Pa* component running in map mode. You can determine the level of path-oriented traffic a particular Nortel Networks Multiservice Switch trunk over ATM is forwarding in map mode by displaying the ATM connection *statistics*.

Procedure steps

1. Display all Multiservice Switch trunks over ATM.

   ```
   display trk/*
   ```

2. Select a trunk from the list, for example 821, and display all active PORS channels on that trunk.

   ```
   display trk/<n> lch/*
   ```

3. Manually display the statistics for each VCC for connections under the ATM interface or virtual path terminators.

   ```
   display atmIf/82 vcc/<vcc> stats
   ```

   If the VCC is associated with a virtual path terminator, the VPI value (0) is the instance of the Vpt component. The VCI value is the instance of the Vcc component.

   You need to manually add the statistics for all VCCs in order to determine the total amount of traffic on the trunk for PORS.

Variable definitions

Variable	Value
<n>	instance number of the Multiservice Switch trunk between 0 and 65535
<vcc>	VCC instance

Displaying trunk statistics

Display trunk statistics in order to monitor trunk performance and identify problems. Nortel Networks Multiservice Switch trunks support spooled statistics which are split into different traffic types (DPRS or PORS). You can monitor each of these statistic groups through corresponding Multiservice Switch trunk statistic subcomponents. These subcomponents are only present when the trunk you are monitoring supports that traffic type.

These statistics provide counts for:

- number of successfully forwarded packets
- unsuccessfully forwarded packets
- number of octets received

Procedure steps

1 Display statistics for all the trunks on a node.

display trunk/* stats

The system displays the following statistics for each trunk on the node:

```
Trk/<n>
  pktFromIf =
  discardUnforward =
  intPktFromIf =
  discardIntUnforward =
  pktFromIfByPrio =
  discPktFromIfByPrio =
  octetFromIfByPrio =
  trunkPktFromIf =
  discardTrunkPktFromIf =
  trunkPktToIf =
  discardTrunkPktToIf =
  areYouThereModeEntries =
  stagingAttempts =
```

2 Display statistics for DPRS and PORS traffic on a trunk.

d trunk/<n> <stats>

Variable definitions

Variable	Value
<n>	instance number of the Multiservice Switch trunk between 0 and 65535
<stats>	is DprsStats, or PorsStats for DPRS and PORS traffic

Alarms and state change notifications

Nortel Networks Multiservice Switch trunks follow the Multiservice Switch approach to the generation of alarms and state change notifications (SCN). In general, the system generates only a single alarm when a fault occurs. If there is a problem with the physical layer, then the responsible component issues an alarm, while the state of the *Trunk* component changes. The *Trunk* component issues an SCN on behalf of the entire protocol stack using the hardware.

For additional information on Multiservice Switch alarms and SCNs, see NN10600-500 *Nortel Networks Multiservice Switch 6400/7400/15000/20000 Alarms Reference*.

Provisioned trunk overrides

Nortel Networks Multiservice Switch trunk overrides consist of two provisionable *Trunk* attributes: *overrideTransmitSpeed* and *overrideRoundTripDelay*. These attributes override the operational *Trunk* attributes *measuredRoundTripDelay* and *measuredSpeedToIf* when reporting to the routing system for metric calculations. You can control the metrics calculated for a Multiservice Switch trunk, and in turn the routing behavior, by using overrides.

If you change either the *overrideTransmitSpeed* or *overrideRoundTripDelay* attribute

- while the *Trunk* component is providing service, then these values are renegotiated with the remote Multiservice Switch trunk with no disruption to the service
- while the Multiservice Switch trunk is still staging, then the trunk immediately restages

If there is a mismatch on two end nodes, the system issues the alarm 7005 0108 (overrideRoundTripDelay) or 7005 0109 (overrideTransmitSpeed). No change in metrics occurs until both ends are running with the same override values.

Trunk protocol idle time out duration

Idle time-out duration specifies the duration a Nortel Networks Multiservice Switch trunk stays enabled even if the node receives no packets from the remote end. This attribute allows you to control the time required to disable the node when the connection between the two ends of the Multiservice Switch trunk is troubled.

The value of the provisionable *Trunk idleTimeOut* attribute determines the trunk's protocol idle time out duration. If the local trunk does not receive any packets from the link for the period specified by this attribute, the node enters Are You There (AYT) mode for up to two seconds. If the node does not receive any packets from the remote end during the AYT mode it restages. If it does receive packets it exits AYT mode and continues to provide service.

The default value for *idleTimeOut* attribute duration is four seconds.

SPO-mux mode for PORS

The *mode* operational attribute on the *Trk*/n *Lch*/m component shows the following values:

- SPO-cell-mux, when a channel is using the new VCC
- AAL5-frame-mux, when a channel is using the existing AAL5 VCC
- frame-mux, on non-ATM FPs

Note: The *localConnection* attribute indicates that the connections are associated with a given provisioned VCC's NEP.

The following example shows the display option and output used on trk/70:

```
d Trk/70 LCh/* mode, localConnection

Trk/70 LCh/1
  mode = AAL5-frame-mux
  localConnection = atmif/70 vcc/0.100

Trk/70 LCh/2
  mode = SPO-cell-mux
  localConnection = atmif/70 vcc/0.101
```

Map mode for PORS

The *mode* operational attribute on the *Trk*/n *Lch*/m component shows the following values:

- AALSPO-cell-map, when a channel is converting from or to small frames (VOICE or BTDS) going to or coming from the nextHop
- AAL5-frame-map, when larger frames (HDLC or frame relay) are going to, or coming from the nextHop
- cell-map, indicates that no conversion is required

The following example shows the display option and output used on trk/70:

```
d Trk/70 LCh/* mode, localConnection

Trk/70 LCh/1
  mode = AAL5-frame-map
  localConnection = atmif/70 vcc/0.141

Trk/70 LCh/2
  mode = AALSPO-cell-map
  localConnection = atmif/70 vcc/0.142

Trk/70 LCh/3
  mode = cell-map
  localConnection = atmif/70 vcc/0.191
```

Definition of the IfTable

The ifTable provides a basic model of a network device containing a set of interfaces. Currently, two RFCs define the ifTable and a proposal for its evolution:

- RFC 1213 Management Information Base for network management of TCP/IP-based internets: MIB-II
- RFC 1573 Evolution of the Interfaces Group of MIB-II

Nortel Networks Multiservice Switch supports ifTable entries for both unackTrunks and atmTrunks. For a detailed description of the ifEntries for the *Trunk* component, see NN10600-300 *Nortel Networks Multiservice Switch 7400/15000/20000 Operations: SNMP*.

Support of SNMP enterprise MIBS

Nortel Networks Multiservice Switch trunks support SNMP Enterprise MIBs.

The following MIBs contains information specific to frame-cell *Trunk* components:

- nortelpp-trunksV1.BE0000.mib
- nortelpp-unackTrunksV1.BE0000.mib
- nortelpp-porsTrunksV1.BE0000.mib
- nortelpp-atmTrunksV1.BE0000.mib

The MIB nortelpp-atmTrunke1.mib contains information specific to Multiservice Switch trunks over ATM components.

Chapter 6
Multiservice Switch trunk troubleshooting

The function processor (FP), the facility, or configuration errors can cause Nortel Networks Multiservice Switch trunk problems.

Multiservice Switch trunk troubleshooting tasks

- "Determining why a frame-cell trunk is not providing service" (page 88)
- "Determining why a frame-cell trunk does not remain connected" (page 90)

For additional troubleshooting aids, see "Multiservice Switch trunk common problems and corrective actions" (page 92).

Determining why a frame-cell trunk is not providing service

Determine why a frame-cell trunk is not providing service. Frame-cell trunks are supported on Nortel Networks Multiservice Switch 7400 series nodes only. Multiservice Switch 15000 and Multiservice Switch 20000 nodes do not support frame-cell trunks.

Prerequisites

- The OSI model states provide valuable feedback for troubleshooting node problems. See "Determining trunk component states" (page 71) for background information.

Procedure steps

1. To verify the status of the trunk node, issue the display command for the failed trunk.

   ```
   display trunk/<n> osistate
   ```

   If adminState = unlocked, operationalState = enabled, and usageState = busy, the trunk is operational. Go to "Determining why a frame-cell trunk does not remain connected" (page 90) to verify trunk statistics.

   If adminState = locked, consult with the operator who took the trunk out of service to verify that you can now unlock the trunk. Issue the unlock command. If the trunk stages, the trunk is operational. Exit this procedure or go to step 3 to verify the status of the logical processor.

   If operationalState = disabled and availabilityStatus = dependency, there is a hardware failure. The possible failed components include the function processor, the individual port, and the trunk facilities. Go to step 3 to verify the status of the logical processor.

   If operationalState = disabled and availabilityStatus = failed, check the trunk alarms.

   If operationalState = disabled and availabilityStatus = inTest, check the trunk statistics in "Determining why a frame-cell trunk does not remain connected" (page 90).

   If operationalState = disabled and availabilityStatus is not dependency, failed, or intest, the trunk never enabled. Go to step 3.

   If operationalState = disabled and availabilityStatus = <empty>, the problem originates at the remote end. Repeat this procedure ("Determining why a frame-cell trunk is not providing service" (page 88)) at the remote end.

2 Determine the logical processor and port assignments.

```
display -p trunk/<n> unacked framer
```

3 To verify the status of the logical processor (LP) issue the display command for the LP on the failed trunk node.

```
display lp/<m> osistate
```

If adminState = unlocked, operationalState = enabled, and usageState = busy, the logical processor is operational. Go to step 4 to verify the status of the port.

If operationalState = disabled and availabilityStatus = dependency, there is a function processor failure. Go to the NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.

4 To verify the status of the port, issue the display command for the physical port on the failed trunk node.

```
display lp/<slot> <interfaceType>/<port>
```

5 If the operationalState = disabled, go to “Testing hardware components” (page 65) to continue the troubleshooting analysis.

Variable definitions

Variable	Value
<interfaceType>	type of interface that failed
<m>	instance number of the failed logical processor
<n>	instance number of the failed Multiservice Switch trunk
<port>	port number of the failed Multiservice Switch trunk
<slot>	slot number of the failed Multiservice Switch trunk

Determining why a frame-cell trunk does not remain connected

Determine why a frame-cell trunk does not remain connected. Frame-cell trunks are supported on Nortel Networks Multiservice Switch 7400 series nodes only. Multiservice Switch 15000 and Multiservice Switch 20000 nodes do not support frame-cell trunks.

Changes in the facility (Framer) statistics at both ends can indicate hardware problems or a mismatch of local and remote provisioning.

Procedure steps

1. Enter the display command for the failed trunk.

   ```
   display trunk/<n> unacked framer
   ```

2. Examine the counts for the displayed errors.
3. Wait for a few seconds.
4. Re-enter the display command for the failed trunk.

   ```
   display trunk/<n> unacked framer
   ```

   If any of these counts are increasing, use the appropriate port testing procedure in “Testing hardware components” (page 65) to isolate the problem to the port on the FP or the communications facility.

5. Examine the counts for the displayed errors.

   If the trunk discard statistics are stable and the Multiservice Switch 7400 node is operational, then the trunk is in a good state.

6. If the trunk discard statistics are increasing and the Multiservice Switch 7400 node is operational, then check if the trunk is congested and troubleshoot routing.
7. If the counts are stable, move to the remote node and continue troubleshooting.
8. If the trunk’s FP is crashing, see the section on determining the cause of an FP crash in NN10600-520 *Nortel Networks Multiservice Switch 7400/ 15000/20000 Fault and Performance Management: Troubleshooting*.

Variable definitions

Variable	Value
<n>	instance number of the failed Multiservice Switch trunk

Multiservice Switch trunk common problems and corrective actions

Table 1, “Common problems and corrective actions summary table,” (page 92) provides guidelines about how to respond to problems that may occur when using frame-cell trunks for the Multiservice Switch 7400 series node and Multiservice Switch trunks over ATM.

Table 1
Common problems and corrective actions summary table

Problems	Probable causes	Trunk		Corrective measures
		Frame -cell	over ATM	
Multiservice Switch trunk does not provide service	Processor module failure or port failure	Yes	Yes	Replace the function processor. See NN10600-175 *Nortel Networks Multiservice Switch 7400 Hardware Installation, Maintenance, and Upgrade*.
	Facilities failure	Yes	Yes	Contact the service provider or Nortel Networks for assistance. See “Nortel Networks support services” in NN10600-030 *Nortel Networks Multiservice Switch 7400/15000/20000 Overview*
	maximumExpected RoundTripDelay is exceeded	Yes	Yes	Either increase the value of the *Trunk* attribute *maximumExpectedRoundTripDelay* (maximum by default) or correct the underlying facility to reduce RTD of the connection. The system issues an alarm (7005 0105) when this problem occurs.
	Incorrect hardware configuration	Yes	Yes	Run port and line tests to verify that the cable and connectors are functioning properly.

(Sheet 1 of 7)

Table 1 (continued)
Common problems and corrective actions summary table

Problems	Probable causes	Trunk		Corrective measures
		Frame -cell	over ATM	
Multiservice Switch trunk does not provide service		Yes	Yes	Verify the following hardware configurations: • cables and connectors at both ends are not faulty (would fail port and line test) • both ends have compatible clocking (Dte/Dce, Master/Slave) • both ends have matching mapping, Cbit Parity
		Yes	No	• both ends have matching speeds; for example, V.35 X.21/HSSI of the Multiservice Switch 7400 series nodes are provisioned with the same lineSpeed values • X.21(only for the Multiservice Switch 7400 series node) line termination is on if speed >=2M or long cables in use
		Yes	No	• both ends have matching timeslots; for example, DS1 Chan or E1 Chan have the same values in timeslots
		No	Yes	• both ends have matching speeds; for example, Vcc Vcds are provisioned with the same PCR values • both ends have VPI/VCI that match the traffic contract • both ends have matching VPI/VCI

Table 1 (continued)
Common problems and corrective actions summary table

Problems	Probable causes	Trunk		Corrective measures
		Frame -cell	over ATM	
Multiservice Switch trunk does not provide service	Framing errors as a result of • incorrect Framer provisioning • faulty hardware • mismatched connection bandwidth (port speeds) • facility problems	Yes	No	The trunk protocol cannot stage or continually provide service if it is using a faulty connection. Check the integrity of the connection to see if it is providing service. Examine the *Framer* attributes contained in the *Framer statistics* group: • *aborts* • *crcErrors* • *lrcErrors* • *nonOctetErrors* • *overruns* • *underruns*
	Inconsistent Framer provisioning at each end of the connection	Yes	No	Verify that the remote and local *Framer* attributes match: • *framingType* • *dataInversion* • *frameCrcType* • *flagsBetweenFrames*

(Sheet 3 of 7)

Table 1 (continued)
Common problems and corrective actions summary table

Problems	Probable causes	Trunk		Corrective measures
		Frame -cell	over ATM	
Multiservice Switch trunk does not provide service	Inconsistent ATM provisioning at each end of the connection	No	Yes	The trunk protocol is encapsulated into an AAL5 format (specified internally as the *AtmAccess* subcomponent). Verify that the remote and local VPI/VCI have the same attributes defined. The following attributes must match at both ends of the connection: • *txTrafficDescType* • *txTrafficDescParm* • *atmServiceCategory* • *trafficShaping* • *rxTrafficDescType* • *rxTrafficDescParm*
(Sheet 4 of 7)				

Table 1 (continued)
Common problems and corrective actions summary table

Problems	Probable causes	Trunk		Corrective measures
		Frame -cell	over ATM	
Multiservice Switch trunk does not provide service	Cell errors as a result of • incorrect ATM provisioning • faulty hardware • mismatched connection bandwidth • facility problems	No	Yes	The trunk protocol cannot stage or continually provide service if it is using a faulty connection. Check the integrity of the underlying VCC to see if it is providing service. See ATM Troubleshooting procedures in, NN10600-715 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Fault and Performance Management*. If the VCC is providing service, check for discard problems on the connection by examining the following attributes of the *VCC* component: • *txCellClp* • *txDiscard* • *txDiscardClp* • *rxCellClp* • *rxDiscard* • *rxDiscardClp*
	Invalid remote	Yes	Yes	The trunk can only provide service if connected to another Multiservice Switch trunk. Any other connection does not stage and does not provide service.
(Sheet 5 of 7)				

Table 1 (continued)
Common problems and corrective actions summary table

Problems	Probable causes	Trunk		Corrective measures
		Frame -cell	over ATM	
Multiservice Switch trunk does not provide service	Mismatch of operational and expected remote NodeName	Yes	Yes	Multiservice Switch trunks have provisionable attributes that specify the remote NodeName with which they are expected to stage. The attributes also specify whether to continue service if the remote differs. The system issues a set alarm when this situation occurs. Verify that the *expectedRemoteNodeId* attribute is either set properly or left blank (that is, set as “”).
Multiservice Switch trunk goes down	There is a problem with the integrity of the connection.	Yes	Yes	Analyze alarms originating from the trunk.
	The ATM layer is no longer providing service.	No	Yes	Analyze alarms originating from the trunk and *VCC* components. If the VCC is no longer providing service, see the troubleshooting procedures in NN10600-715 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Fault and Performance Management*.
	Remote function processor is crashing	Yes	Yes	See NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.
Multiservice Switch trunk performance problem	Congestion, network instability, or trunk connectivity problems.	Yes	Yes	Sample the trunk statistics several times to determine if the following statistics are increasing: • discardUnforward • discardTrunkPktFromIf • discardIntUnforward

(Sheet 6 of 7)

Table 1 (continued)
Common problems and corrective actions summary table

Problems	Probable causes	Trunk		Corrective measures
		Frame -cell	over ATM	
Multiservice Switch trunk does not come up	Total bandwidth is exhausted on the interface.	No	Yes	Change total bandwidth requests for the connection either by changing requested peak cell rates or by removing the connection.
	Routing rejects trunk from staging	Yes	Yes	Check the regionIds and RIDs of the two nodes. If the regionIds are different, verify that RIDs are also different. Check if the number of trunks in a link group exceed the maximum allowed by routing. The system issues an alarm (7005 0103) when this problem occurs.
Multiservice Switch trunk fails intermittent-ly, Multiservice Switch node or transmission facility, or both loses synchroni-zation, detects transmission errors.	A *lineType* attribute of D4 and a *zeroCoding* attribute of AMI and facility for trunks carrying: IP traffic; a trunk packet payload that could include a long stream of zeros; or both.	Yes	No	Set the *lineType* attribute to ESF and the *zeroCoding* attribute to B8ZS under the *lp*/x *ds1*/y component.

(Sheet 7 of 7)

Chapter 7
Understanding Multiservice Switch trunking

This section describes the following trunking information:

- "Multiservice Switch trunking terms" (page 99)
- "Multiservice Switch trunking functions" (page 100)
- "Multiservice Switch trunking architecture" (page 101)
- "Multiservice Switch trunking mechanisms" (page 116)

For an introduction to Nortel Networks Multiservice Switch trunking, see NN10600-030 *Nortel Networks Multiservice Switch 7400/15000/20000 Overview*.

Multiservice Switch trunking terms

Nortel Networks Multiservice Switch trunking terms are very specific. See Table 2, "Multiservice Switch trunking terms," (page 99) for definitions.

Table 2
Multiservice Switch trunking terms

Trunking term	Trunking definition
trunk	generic term for a physical connection, not a Multiservice Switch node-specific term
Multiservice Switch trunk	Node-to-node connection supporting Multiservice Switch core networking. Multiservice Switch trunks support dynamic packet routing system (DPRS), and path-oriented routing system (PORS).
(Sheet 1 of 2)	

Table 2 (continued)
Multiservice Switch trunking terms

Trunking term	Trunking definition
Trunk component	component type for a Multiservice Switch trunk
inter-region Multiservice Switch trunk	A trunk which is a link between two Multiservice Switch border nodes in different topology regions.
Multiservice Switch trunking system	Software system that implements Multiservice Switch trunking functions
frame-cell trunk	Transport mechanisms used by Multiservice Switch trunks to carry both frame and cell traffic on a frame-based interface. HDLC mode is a provisionable mode in which a frame-cell trunk can operate and that uses HDLC framing. Interrupting mode is a provisionable mode in which a frame-cell trunk can operate and that uses a modified HDLC-based framing. Interrupting mode allow highest priority data to interrupt traffic less sensitive to delay or traffic with a lower emission priority.
Multiservice Switch trunk over ATM	Transport mechanism used by Multiservice Switch trunks to carry cell traffic on an ATM-based interface
Unacknowledged (UnAcked) subcomponent	component type for frame-cell trunks, both HDLC and interrupting modes
ATM link	standards-based ATM connection

(Sheet 2 of 2)

Multiservice Switch trunking functions

A Nortel Networks Multiservice Switch trunk is a proprietary point-to-point protocol that connects two Multiservice Switch nodes. The Multiservice Switch trunking system provides this protocol and performs the following functions:

- implements Multiservice Switch network layer functions in support of trunks, such as reporting status of usable trunks
- controls a protocol stack associated with a logical port on a function processor (FP) that provides interconnection to another Multiservice Switch node or external network
- interfaces with the port management system (POMS)

- implements an unacknowledged protocol and supports ATM connections for Multiservice Switch node-to-node connectivity
- interwork with the node and network management systems through the component administration system (CAS) and the data collection system (DCS)

Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 trunks over ATM can be provisioned on a spared LP as warm standby features. A warm standby application or feature can operate together with a hot standby application or feature on the same FP without affecting the ability of the hot standby application or feature to provide hitless services.

See NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures* for a description of hitless services and hot, warm and cold standby applications and features.

Multiservice Switch trunking architecture

Nortel Networks Multiservice Switch node-to-node links are called Multiservice Switch trunks. A Multiservice Switch trunk is a point-to-point or logical (ATM virtual channel connection [VCC]) connection between two Multiservice Switch nodes over which Multiservice Switch proprietary routing protocols are run. Multiservice Switch trunks use two transport mechanisms: frame-cell and Multiservice Switch trunks over ATM. Nortel Networks Multiservice Switch 7400 series nodes use both frame-cell and Multiservice Switch trunks over ATM. Multiservice Switch 15000 and Multiservice Switch 20000 nodes do not use frame-cell trunks.

- Nortel Networks Multiservice Switch frame-cell trunks transport data traffic (frame relay, and DPN-100) as frames, and constant bit rate traffic (voice, and video) as cells. The Unacknowledged (UnAcked) trunking protocol used for transmission is HDLC-based.
- Multiservice Switch trunks over ATM (formerly called ATM logical trunks) are cell trunks that encapsulate frame traffic into ATM cells. The Multiservice Switch trunk over ATM is carried on one or more ATM VCCs and uses standard ATM adaptation layer protocols based on AAL1 and AAL5.

Multiservice Switch trunking system interacts with several Multiservice Switch software subsystems, as Figure 11, “Frame-cell trunks software architecture,” (page 103) and Figure 12, “Multiservice Switch trunks over ATM software architecture,” (page 104) illustrate.

See the following sections for information on the Multiservice Switch trunking architecture:

- “Multiservice Switch software subsystems support of trunking” (page 105)
- “Transport mechanisms support of Multiservice Switch trunking” (page 107)
- “Multiservice Switch trunks protocol stacks” (page 108)
- “Supported interfaces for Multiservice Switch trunking” (page 115)

Figure 11
Frame-cell trunks software architecture

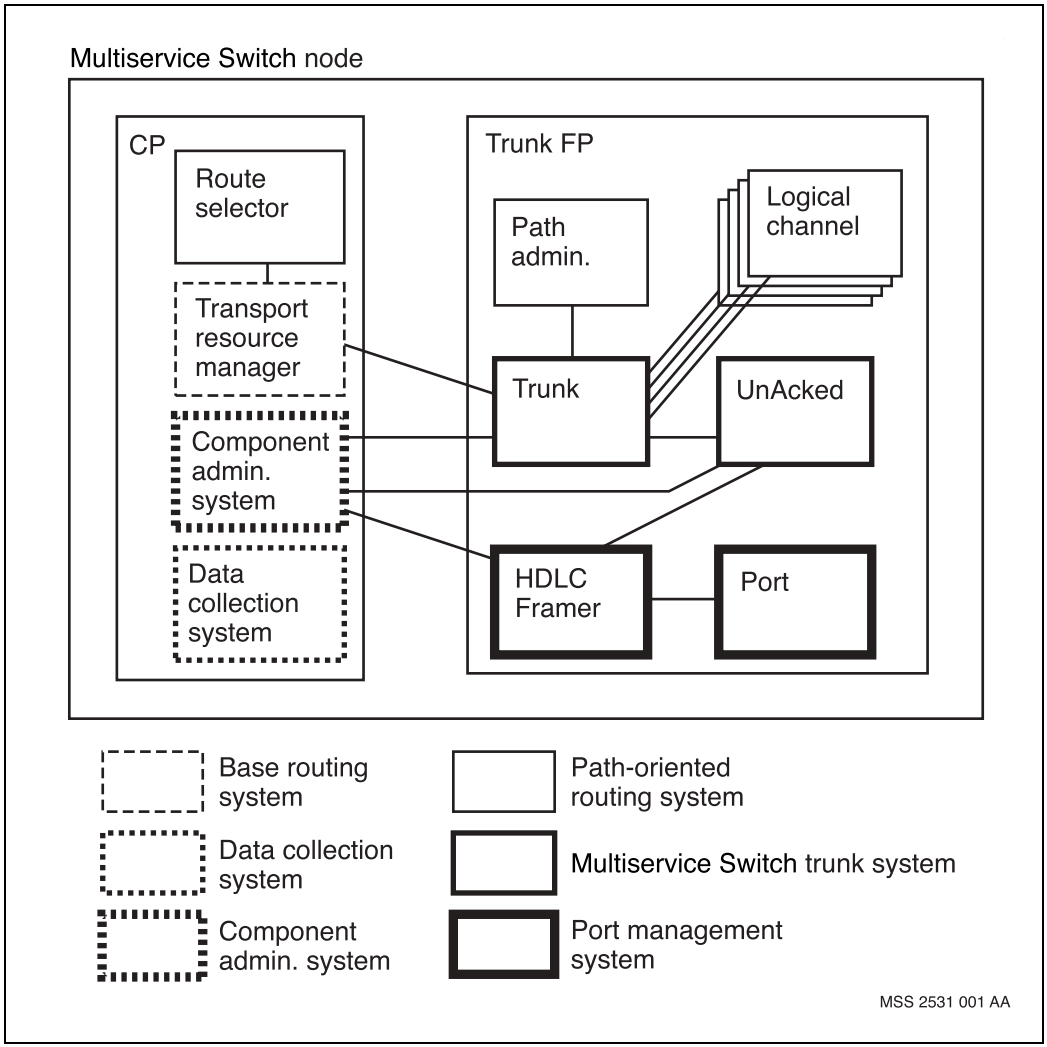
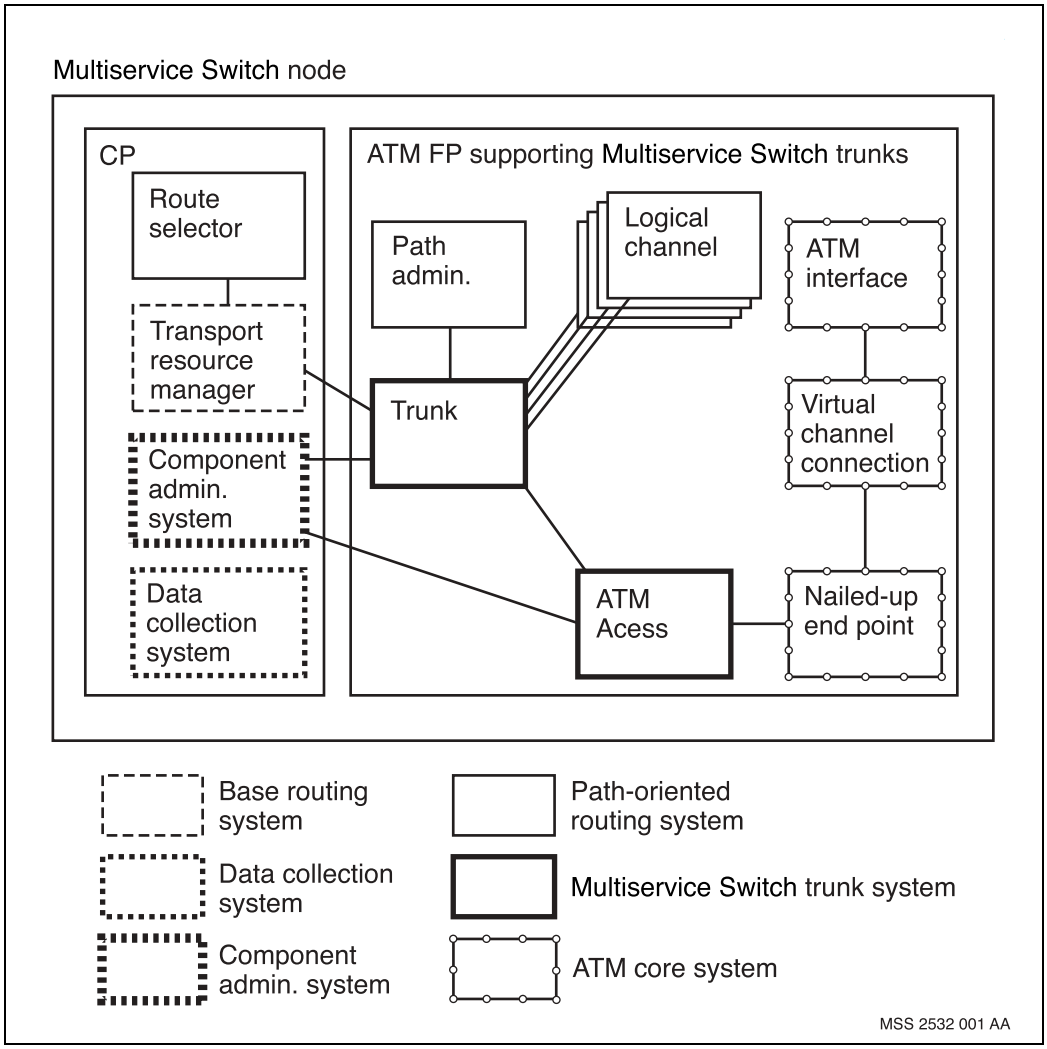


Figure 12
Multiservice Switch trunks over ATM software architecture



Multiservice Switch software subsystems support of trunking

The following sections describe the software subsystems supporting Nortel Networks Multiservice Switch trunking:

Base routing system support of Multiservice Switch trunking

Transport resource manager (TRM) in the base routing system interfaces with the Multiservice Switch trunk system to learn

- the status (up or down) of all usable Multiservice Switch trunks
- the Multiservice Switch trunk attributes to support various classes of routing (throughput, delay, multimedia, cost)
- neighbor node information
- the maximum frame size

Base routing and the routing protocols use this information to compute the metrics for selecting routes.

Path-oriented routing system (PORS) support of Multiservice Switch trunking

Interrupting trunks provide PORS with the interrupting hardware queue (used for voice and video delay-variation-sensitive traffic) and both the high and normal hardware queues. Route selector is responsible for choosing PORS connections (routes) through a module. Path administrator is responsible for

setting up and controlling PORS connections on a Multiservice Switch trunk. Logical channel, in conjunction with path administrator, controls a Multiservice Switch trunk PORS connection.

Port management system (POMS) support of Multiservice Switch trunking

POMS provides the Multiservice Switch trunking system with the physical interfaces (ports) for transmitting and receiving traffic over Multiservice Switch trunks. POMS is a software system that controls and monitors the physical interfaces supported by FPs. POMS also manages the physical lines from the Multiservice Switch node to other network elements and monitors the link for quality.

Data collection system (DCS) support of Multiservice Switch trunking

Data collection system (DCS) collects and stores alarms, statistics, and state change notifications generated by Multiservice Switch trunking.

Component administration system (CAS) support of Multiservice Switch trunking

Component administration system (CAS) provisions and monitors the hardware and software components comprising Multiservice Switch trunking. The trunk system components interact with CAS for processing operator commands, handling alarms and statistics, and for interacting with the provisioning system.

Multiservice Switch trunking system

Multiservice Switch trunking system has a layered architecture that spans two well defined OSI model protocol layers: the data link layer and the network layer. This architecture corresponds to the bottom of the Multiservice Switch network layer and the top of the switching layer. See “Multiservice Switch trunks protocol stacks” (page 108).

ATM core system

Multiservice Switch node’s switching layer contains the Multiservice Switch ATM core system. See “Multiservice Switch trunks protocol stacks” (page 108).

Transport mechanisms support of Multiservice Switch trunking

Transport mechanisms can be acknowledged or unacknowledged. With unacknowledged trunks, receiving nodes do not acknowledge the receipt of packets. This method is optimal for high quality transmission lines (extremely low bit-error rates). Unacknowledged trunking reduces link processing and overhead (associated with acknowledgment), and provides for higher performance.

Highlights of unacknowledged trunks compared to acknowledged trunks are

- less trunk overhead and higher throughput
- interrupting capability

The transport mechanisms for unacknowledged Nortel Networks Multiservice Switch trunks are

- "Frame-cell trunks on a Multiservice Switch 7400 series switch" (page 107)
- "Multiservice Switch trunks over ATM" (page 107)

Frame-cell trunks on a Multiservice Switch 7400 series switch

Frame-cell trunks use point-to-point connections, where bandwidth is dedicated to one user (directly over physical circuits). All frames use the HDLC-framed format when transmitting across the lines.

Frame-cell trunks are either HDLC-based or interrupting. The default mode is interrupting. The interrupting feature can be provisioned on each Multiservice Switch trunk, on a port-by-port basis. This feature allows highest priority data to interrupt traffic which is less sensitive to delay or which has lower emission priority. Multiservice Switch trunking supports three data emission priorities (priority of data as determined by its urgency). See "Traffic management for frame-cell trunks" (page 124) for more information.

Multiservice Switch trunks over ATM

Multiservice Switch trunks over ATM use bandwidth only when needed. The bandwidth appears to be dedicated. More bandwidth can be used if necessary and if available.

Multiservice Switch trunks over ATM allow all non-ATM Multiservice Switch services and DPN-100 traffic to travel transparently over ATM. The routing system uses trunks over ATM in the same way as frame-cell trunks, replacing the unacknowledged sublayer with an ATM sublayer.

The ATM protocol consists of VCC access through ATM adaptation layer 5 (AAL5), or AAL short path-oriented (AALSPO) for voice. The ATM layer segments the frames into cells and transmits them across the VCC link. Each Multiservice Switch trunk over ATM uses one or more ATM VCC.

Multiservice Switch trunks over ATM are either direct or logical:

- direct trunks over ATM connect Multiservice Switch nodes directly together
- logical trunks over ATM connect Multiservice Switch nodes either through a series of nodes or through an external ATM network

For more information on Multiservice Switch trunks over ATM, see "Multiservice Switch trunks over ATM" (page 137).

Multiservice Switch trunks protocol stacks

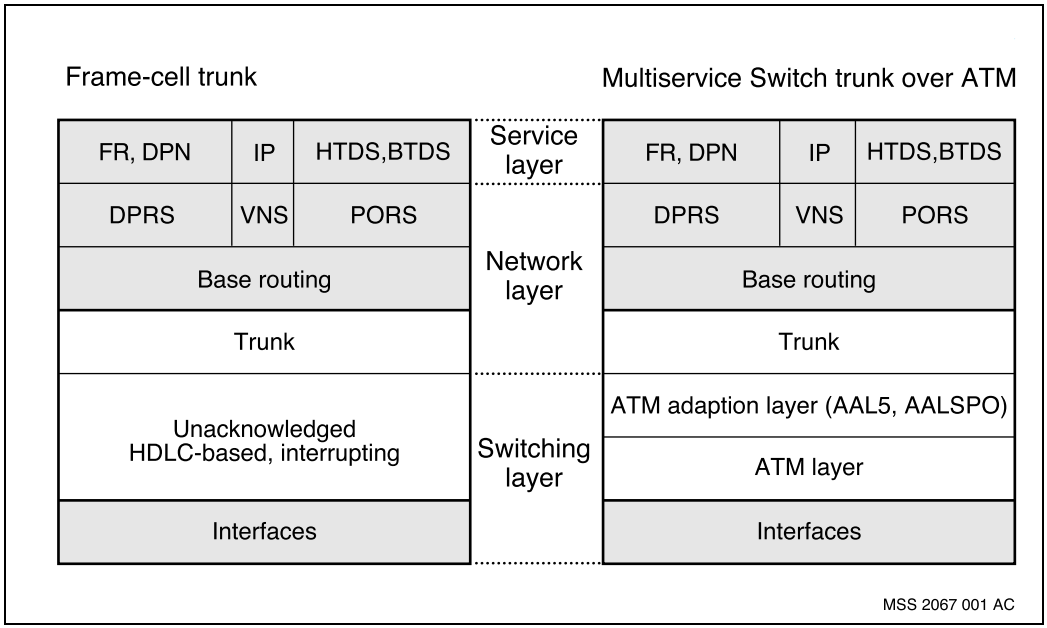
Nortel Networks Multiservice Switch trunk architecture is a protocol stack. A protocol stack identifies a group of hierarchical functions divided into layers, in which each layer provides a service to the layer above it.

Multiservice Switch trunk over ATM protocol stacks are similar to the protocol stack of frame-cell trunks. All the layers above the unacknowledged layer in the frame-cell stack and all the layers above the AAL layer in the Multiservice Switch trunk over ATM stack are the same. The difference between the two stacks is the architecture of the switching group of layers. The HDLC-based stack is made up of the unacknowledged layer and the physical layer. Multiservice Switch trunk over ATM protocol stacks are made up of the AAL5 layer, the AALSPO layer, the ATM layer, and the physical layer.

The following sections describe the Multiservice Switch architecture layers:

- "Multiservice Switch network layer" (page 109)
- "Multiservice Switch switching layer" (page 110)

Figure 13
Comparison of Multiservice Switch trunk protocol stacks



Multiservice Switch network layer

The Multiservice Switch trunk sublayer of the network layer corresponds to the OSI model layer-three (L3) process (OSI model network layer). The Multiservice Switch trunk sublayer is responsible for

- staging (establishing) the point-to-point Multiservice Switch trunk
- providing an interface to the routing system independent of Multiservice Switch node switching
- layer
- testing and managing the connection
- reporting link characteristics to base routing such as availability, connection bandwidth (speed), delay, remote node identification, three emission priority queue identifiers, static PORS attributes (such as cost, trunk type, security), allocated PORS bandwidth, and number of currently established PORS connections

Base routing only supports protocol stacks with the Multiservice Switch trunk protocol for Multiservice Switch node-to-node networking.

Multiservice Switch switching layer

The Multiservice Switch trunk sublayer of the Multiservice Switch node's switching layer corresponds to an OSI model L2 process (OSI model data link layer). This sublayer provides

- the capability for transfer of packets across point-to-point links independent of the transmission facility used
- a pipe available to upper layers
- Multiservice Switch trunk characteristics such as availability and connection bandwidth. Frame-cell trunks support three emission priorities: normal, high, and interrupting.
- the interface with the POMS which implements the OSI model physical layer for point-to-point trunks
- access to channels of a service for logical trunking

Frame-cell and Multiservice Switch trunks over ATM are the only transport mechanisms supported. Transport mechanisms, such as FR, X.25, and IEEE 802.2 are possible future candidates.

OSI states for Multiservice Switch trunks

The following sections have information on *Trunk* component states:

- "OSI model administrative state for Multiservice Switch trunks" (page 110)
- "OSI model operational state for Multiservice Switch trunks" (page 111)
- "OSI model usage state for Multiservice Switch trunks" (page 111)
- "Summary of OSI model state combinations for Trunk, Unacknowledged, and AtmAccess components" (page 112)

OSI model administrative state for Multiservice Switch trunks

The OSI model administrative state attribute (locked/unlocked) indicates whether the *Trunk* component is available for service. If the Nortel Networks Multiservice Switch trunk is out of service due to a lock command, then an unlock command is necessary to bring it back to service. After issuing the

unlock, if the component does not come into full operation then you need to investigate the higher level components or subcomponents, and the states of the other two state attributes.

> ***Note:*** *UnAcked* and *AtmAccess* components do not support lock/unlock commands and always have administrative states of unlocked.

OSI model operational state for Multiservice Switch trunks

The OSI model operational state attribute (enabled/disabled) indicates the status of a trunk's subcomponents. If any subcomponent is troubled then the operational state attribute has a value of disabled. The following are some of the most common scenarios:

- availabilityStatus = dependency indicates that the component has a dependency, such as a subcomponent, being disabled
- availabilityStatus = inTest indicates that the component is currently in test mode and trying to stage
- availabilityStatus = failed indicates that the component has detected either a loss of some resource, has encountered a protocol violation, or has lost communications with a remote component. The *Trunk* component issues a set alarm for any such failure.
- controlStatus = suspended indicates that the administrator has locked the component or some other software entity has disabled it

OSI model usage state for Multiservice Switch trunks

The OSI usage state attribute (idle/busy) indicates whether the component is being used or not. There are several reasons why a Multiservice Switch trunk usage state is idle, meaning that the component has no user:

- if the routing system is not using the *Trunk* component for its topologies
- if the *Trunk* component is not using the *UnAcked* or *AtmAccess* components
- if the remote Multiservice Switch trunk is troubled

See Table 1, "Common problems and corrective actions summary table," (page 92) and for assistance in troubleshooting.

Summary of OSI model state combinations for Trunk, Unacknowledged, and AtmAccess components

Note: The Unacknowledged components are specific to the Nortel Networks Multiservice Switch 7400 series nodes.

Table 3, "Trunk component state combination," (page 112), Table 4, "Unacknowledged component state combination," (page 113), and Table 5, "AtmAccess component state combination," (page 113) summarize the OSI model state combinations for *Trunk*, *Unacknowledged*, and *AtmAccess* component states, respectively.

Table 3
Trunk component state combination

Combination (Administrative, Operational, Usage)	Details
Unlocked, Disabled, Idle	External factors render the Multiservice Switch trunk inoperable. The *Unacknowledged* or *AtmAccess* subcomponents reporting a link down is a possible cause. Bad line state and excessive line state changes are possible causes.
Unlocked, Enabled, Idle	The *Unacknowledged* or *AtmAccess* subcomponent is offering service and the Multiservice Switch trunk is now staging with the remote.
Unlocked, Enabled, Busy	The *Trunk* component is in use. The component does not service any user (that is, any component) but has successfully joined packet routing.
Locked, Disabled, Idle	In addition to a lock/lock -force command being in effect, the *Unacknowledged* or *AtmAccess* subcomponent is reporting a link down. Bad line state and excessive line state changes are possible causes.
ShuttingDown, Enabled, Busy	A lock command is in effect. The *Trunk* component is waiting for any *logicalChannel* subcomponents to go away before entering the locked state.

Table 4
Unacknowledged component state combination

Combination (Administrative, Operational, Usage)	Details
Unlocked, Disabled, Idle	External factors render the *Unacknowledged* component inoperable. The *Framer* component reporting a link down is a possible cause.
Unlocked, Enabled, Idle	The *Framer* subcomponent is offering service and the *Unacknowledged* component is now waiting for the parent component to start using it.
Unlocked, Enabled, Busy	The *Unacknowledged* component is in use. The component services only one user (a *Trunk* component) at a time.

Table 5
AtmAccess component state combination

Combination (Administrative, Operational, Usage)	Details
Unlocked, Disabled, Idle	External factors render the *AtmAccess* component inoperable. The ATM connection reporting a link down is a possible cause.
Unlocked, Enabled, Idle	The ATM connection is offering service and the *AtmAccess* component is now waiting for the parent component to start using it.
Unlocked, Enabled, Busy	The *AtmAccess* component is in use. The component services only one user (a *Trunk* component) at a time.

Operational disabling of Multiservice Switch trunks

You can disable a Nortel Networks Multiservice Switch trunk node by using the lock command on either the *Trunk* component, or on the component controlling the port that the trunk is using. A disabled trunk is available for port testing.

Multiservice Switch trunks must be locked before you can perform port tests. The *Trunk* component controls a logical port on a function processor. This *Trunk* component provides a connection to a *Trunk* component on another

network element. For details on *Trunk* components, see NN10600-060 *Nortel Networks Multiservice Switch 7400/15000/20000 Component Reference*. The system issues an alarm whenever a trunk becomes locked.

When you lock a trunk for a port test, its operational state becomes disabled and its administrative state becomes locked. The administrative state becomes unlocked after five minutes even if the test is not complete. The operational state, however, remains disabled until the test is complete. Once the test is complete, the operational state changes to the enabled state and the trunk attempts to become operational.

CAUTION
Risk of data loss
Locking a Multiservice Switch trunk can result in the loss of data. To reduce the risk of data loss, do not lock a trunk during peak periods of traffic.

The Multiservice Switch trunk restaging mechanism

Nortel Networks Multiservice Switch trunks implement a backoff mechanism when restaging from a hardware-related fault. This mechanism reduces the amount of routing traffic generated by a Multiservice Switch trunk that was repeatedly enabled and disabled.

The first time a trunk is disabled due to a facility problem, the trunk restages immediately. Following the second disabling the trunk waits for 10 seconds after the facility is operational before attempting to restage. Subsequent failures result in the trunk waiting for 20 and then for 40 seconds after the facility is operational before attempting to restage. This restaging mechanism cycles through the 10-, 20-, and 40-second periods until the trunk is successful.

Once a Multiservice Switch trunk is operating error-free for 10 minutes, the restaging mechanism resets to restage immediately before cycling through the 10-, 20-, and 40-second waiting periods.

See Table 6, “Multiservice Switch trunk restaging scenarios,” (page 115) for restaging scenarios.

Table 6
Multiservice Switch trunk restaging scenarios

Failure scenarios	Restaging description and times
Administrative Lock/Unlock of a *Trunk* component using a back-to-back facility	The locking of a Multiservice Switch trunk on one end of a connection results in the other end of the trunk detecting loss of communications and attempting to restage. When you unlock the Trunk, both ends of the Trunk stage immediately.
Administrative Lock/Unlock of a port component using a back-to-back facility	The locking of the port on one end of the connection results with a disabling of the facility. When you unlock that port, both trunks use the backoff mechanism before restaging.
Failure of a back-to-back facility	Both ends of the connection detect the failure of the facility. When that facility is operational, both trunks use the backoff mechanisms before restaging.
Administrative Lock/Unlock of a *Trunk* component using a modem or ATM facility	The locking of a Multiservice Switch trunk on one end of the connection results with the remote trunk detecting a loss of communications. When you unlock this trunk, the other trunk restages immediately.
Administrative Lock/Unlock of a port component using a modem or ATM facility	The locking of a port on one end of the connection results with the remote trunk detecting a loss of communications. When you unlock this port, the other trunk restages immediately.
Failure of a modem facility	The local trunk detects the failure of a modem and the remote trunk detects a loss of communications with this trunk. When the modem is operational the local trunk uses the backoff mechanism before restaging while the remote trunk immediately attempts to restage.
Failure of an ATM facility	Neither Multiservice Switch trunk detects the failure of an ATM facility but both detect a loss of communication with each other. When the ATM is operational both trunks attempt to restage immediately.

Supported interfaces for Multiservice Switch trunking

For information on which specific function processors (FP) support frame-cell trunks and which FPs support Nortel Networks Multiservice Switch trunks over ATM refer to NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference* or contact your Nortel Networks account representative.

Multiservice Switch trunking mechanisms

Nortel Networks Multiservice Switch trunking mechanisms detailed in this section are functions performed by the Multiservice Switch trunking system and include the following:

Trunk component naming

Trunk components have a five-digit instance value. The range of *Trunk* component instances increased from four digits (1 to 1023) to five digits (0 to 65535). This feature allows customers and off-switch tools, such as network management tools, to implement more flexible naming conventions.

The following points describe a popular naming convention:

- the first digit (or two digits) represent(s) the card number
- the next digit represents the port number
- the final two digits represent the channel number

Using this naming convention with the longer instance value, allows for easier troubleshooting by network operators.

Trunk component instance synchronization

Both ends of a connection need to use the required software (P4.2) to incorporate the five-digit instance advantages. The instance value length is checked during Multiservice Switch trunk staging. See "Multiservice Switch trunk staging" (page 117). If only one end of a Multiservice Switch trunk uses a five-digit instance value, the local trunk raises a major alarm because of the impact to the spooled statistics at the end with the older software. The impact is that the *remoteComponentName* attribute in the spooled statistics or on the

operator console does not show the most significant digit in the Trunk instance. For example, *Trunk* component instance 12345 is shown as 2345. This result can affect the off-switch tools that use bulk data format.

Multiservice Switch trunk staging

The process of staging a Nortel Networks Multiservice Switch trunk involves establishing the connection between Multiservice Switch nodes, and occurs after activating a Multiservice Switch trunk. Staging occurs when a physical or logical (ATM) connection comes up between two provisioned *Trunk* components (on different Multiservice Switch nodes). Multiservice Switch trunks also attempt to restage if the error rate on an existing trunk exceeds a threshold.

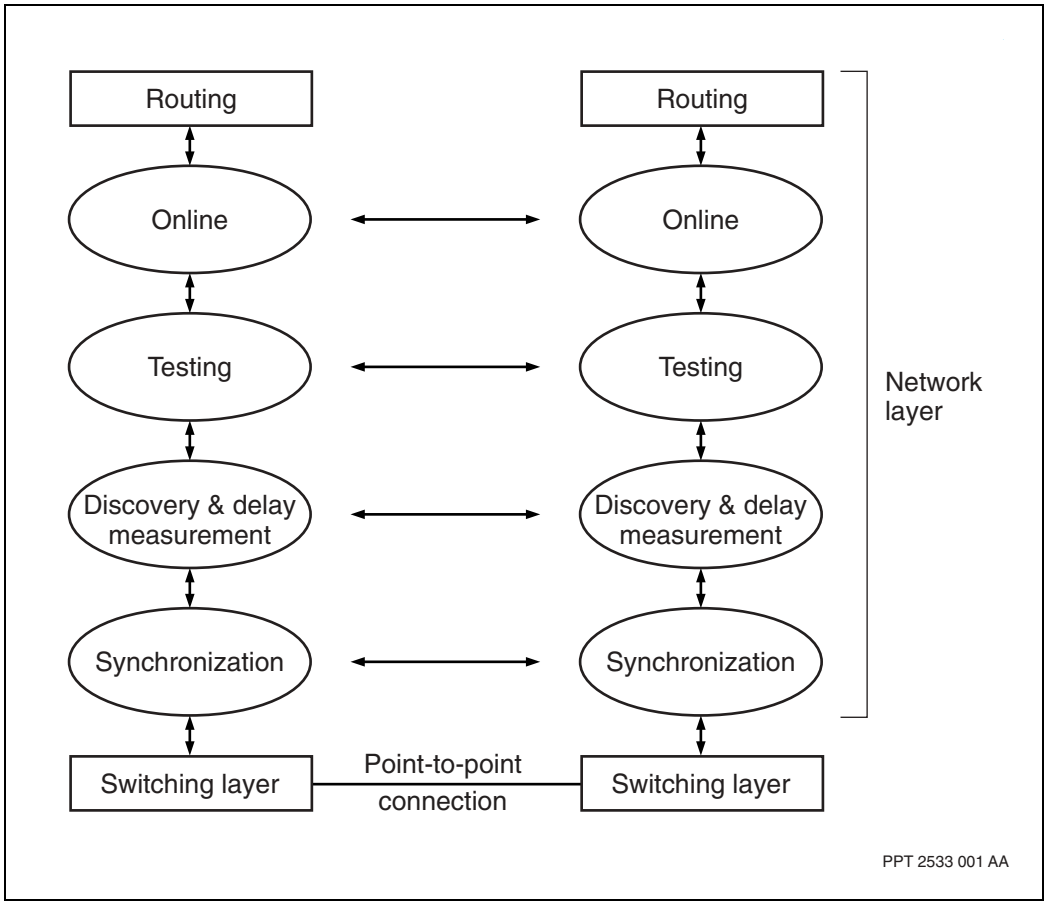
The staging method for the *Trunk* component starts with the interface (*Framer* or *AtmIf* component) indicating to its upstream component (*UnAcked* or *AtmAccess*) that the link connectivity has been established. The upstream component (*UnAcked* or *AtmAccess*) then performs its staging and testing before giving the same indication to the next upstream component (*Trunk*). Upon receiving an enable indication from a downstream component (*UnAcked* or *AtmAccess*), the *Trunk* component performs its staging protocol. The staging is complete when the Multiservice Switch trunk joins the routing system successfully.

Multiservice Switch trunk staging protocols performs the following tasks:

- “Synchronization” (page 118)
- “Discovery and delay measurement” (page 119)
- “Testing” (page 119)
- “Online monitoring” (page 119)
- “Interface with routing system” (page 120)

See Figure 14, “Tasks performed by the Multiservice Switch trunk staging protocol,” (page 118) for an illustration of the trunk staging protocol tasks.

Figure 14
Tasks performed by the Multiservice Switch trunk staging protocol



Synchronization

Synchronization ensures the local and remote nodes are aware of each other. The synchronization protocol transmits and receives Nortel Networks Multiservice Switch trunk up and ready packets with the remote node. For Multiservice Switch trunks over ATM, these up and ready packets traverse the VCC provided by the *AtmAccess* subcomponent.

Discovery and delay measurement

After both ends of the Multiservice Switch trunk have synchronized, each end sends an are-you-there (AYT) packet to exchange attributes such as remote node name. If the actual peer end name is different than the expected remote node name, an alarm appears and the validation action results. The *remoteValidationAction* attribute can be set to continue, where staging continues immediately, or to disable, where restaging occurs after a one-minute time out.

If the connection is deemed valid, then staging continues. One end measures round trip delay (RTD) in milliseconds using a 128-byte packet and then sends the measured value to the remote end.

Testing

The link quality test protocol transmits and receives 64 Multiservice Switch trunk test packets of various lengths. For Multiservice Switch trunks over ATM, the test packets traverse the atmConnection. If a packet is lost, the trunk becomes disabled and attempts to restage.

The adjustment of the staging *Trunk idleTimeOut* attribute acts as a security timer in case packets are lost and the protocol is waiting. If staging is not done within the time specified, then the Multiservice Switch trunk restages.

Online monitoring

The online monitoring protocol informs the routing system of the bandwidth and the delay associated with the Multiservice Switch trunk connection. Online monitoring also provides the routing system with the remote node identification. The switching layer uses the enable indication message to provide information about the bandwidth to online monitoring. After the Multiservice Switch trunk is online (available for use), monitoring continues for failure conditions.

The trunking system removes the Multiservice Switch trunk or identifies it as failed if any of the following occurs:

- there is a looped-back condition
- the trunk loses communication with its peer
- there is a physical failure, such as the loss of the carrier
- a user requests that the Multiservice Switch trunk be terminated

The following describes the monitor mechanism that detects looped-back conditions and lost communications with a peer:

- The remote end sends a neighbor check packet every two seconds. When this packet arrives, the local end validates the remote node identification. The Multiservice Switch trunk restages if the node identification does not match the staged value.
- If the local end does not receive a neighbor check for a period of four seconds, then the remote end transmits 40 AYT packets within a period of two seconds. If the local end does not receive a "Yes I Am" (YIA) packet, then the Multiservice Switch trunk disables. If the local end receives a YIA packet, then the local end validates the remote node identification and continues to provide service.
- If both ends of the Multiservice Switch trunk have agreed to use the enhanced trunk neighbor check procedure then the Multiservice Switch trunk no longer disables after four seconds without receiving a neighbor check packet from the remote Multiservice Switch node.

You can adjust the *Trunk idleTimeOut* attribute to enable quicker rerouting or to be less reactive on slow or erroneous connections. For provisioning information, see "Trunk protocol idle time out duration" (page 81).

Interface with routing system

The *Trunk* component gives an enable indication to its upstream component (routing system) to complete the staging process. This join request contains the remote component name, an RCOS table containing hardware IDs or software IDs or a mixture of the two.

Link quality mechanism

For network stability, Nortel Networks Multiservice Switch trunks need to disable in poor link quality situations. Line noise, equipment failure, and buffer overruns are some of these situations. Automatic disabling applications guarantee link quality and deliver traffic efficiently.

The link quality mechanism can be divided into two elements:

- "Link quality monitoring" (page 121)
- "Link quality policy" (page 121)

Link quality monitoring

The link quality monitoring determines when and how often a link between two Multiservice Switch nodes experiences corrupted data packets being transferred. The *UnAcked* and *AtmAccess* components perform the link quality monitoring based upon raw statistics from the switching layer interfaces.

Link quality policy

The link quality policy judges link quality, and determines what to do when the quality is inadequate. The *Trunk* component has its own link quality policy called error threshold policy.

Two provisionable attributes exist under the *Trunk UnAcked* and *AtmAccess* components to support the link quality mechanism. The *maximumErroredInterval* attribute specifies the interval time over which the error threshold (as specified by *receiveErrorSensitivity*) must be continuously exceeded before the *UnAcked* and *AtmAccess* components can be degraded. The *UnAcked* and *AtmAccess* components issue an alarm once the error interval count exceeds the provisioned value. A *maximumErroredInterval* attribute value of zero (default) disables the mechanism.

The second attribute *receiveErrorSensitivity* is the allowable error rate beyond which the *UnAcked* and *AtmAccess* components can be degraded if it persists for a duration longer than the *maximumErroredInterval*. The threshold is expressed as a percentage of number of frames/cells in error per number of frames/cells received in the last interval (one minute). A *receiveErrorSensitivity* attribute value of zero disables the mechanism.

When the Multiservice Switch trunk crosses the provisioned link error threshold, the Multiservice Switch trunk automatically restages and issues alarms.

Cyclic redundancy checks for Multiservice Switch trunks

For high availability, Nortel Networks Multiservice Switch trunking systems verify the integrity of frames through cyclic redundancy checks (CRC) performed in hardware. Multiservice Switch trunking systems discard frames with errors when the frames arrive from the link. Hardware provides CRC functionality.

Traffic management for Multiservice Switch trunking

For information on traffic management, see:

- "Traffic management for frame-cell trunks" (page 124)
- "Traffic management for Multiservice Switch trunks over ATM" (page 146)
- NN10600-030 *Nortel Networks Multiservice Switch 7400/15000/20000 Overview*
- NN10600-705 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Traffic Management Fundamentals*

Multiservice Switch trunk utilization alarm

The Nortel Networks Multiservice Switch trunk utilization alarm allows the operator to specify whether or not alarms should be generated when the link utilization crosses certain thresholds. There are three user-defined thresholds (one for a minor alarm, one for a major alarm, and one for a critical alarm), which you can provision.

This feature exists for both frame-cell trunks and trunks over ATM. See "Configuring frame-cell trunk features" (page 26) for frame-cell trunks, or "Provisioning Multiservice Switch trunks over ATM features" (page 44) for Multiservice Switch trunks over ATM.

Chapter 8
Multiservice Switch frame-cell trunks

The frame-cell trunks mechanisms detailed in this section are functions performed by the Nortel Networks Multiservice Switch trunking system for Multiservice Switch 7400 series nodes. Multiservice Switch 15000 and Multiservice Switch 20000 nodes do not use frame-cell trunks. This section includes information on the following:

- "Data flow through the Multiservice Switch system" (page 123)
- "Traffic management for frame-cell trunks" (page 124)
- "Dynamic Multiservice Switch trunk speed change for frame-cell trunks" (page 128)

Data flow through the Multiservice Switch system

Hardware and software control data flow through the Nortel Networks Multiservice Switch system.

Frames enter the Multiservice Switch node through the interfacing FP where they are stored in memory. Multiservice Switch node software then determines each frame's destination. The hardware then moves the frames through the processor without further software intervention. This approach increases overall Multiservice Switch system throughput.

Incoming and outgoing frames line up in queues. Queuing allows the Multiservice Switch node to handle the bursty nature of data and to implement parts of protocols that require, for example, frame reassembly.

Queues are also necessary for multiplexing different kinds of traffic on the same facilities. Higher priority queues are for delay-critical frame traffic. The highest priority interrupting queue is for delay-critical applications such as bit-transparent data service, voice, and frame relay multimedia traffic.

Traffic management for frame-cell trunks

The Nortel Networks Multiservice Switch trunking system provides traffic management functionality through the multipriority system (MPS). MPS is a queueing architecture that uses emission priorities to define the urgency of packet transfer and discard priorities to define importance of packet transfer. These two priority types work independently. See the traffic management chapter of NN10600-030 *Nortel Networks Multiservice Switch 7400/15000/20000 Overview* for a thorough explanation of this feature.

Frame-cell trunk emission priority queues

How trunks handle traffic depends on the relationship between the frame-cell trunk mode, and the routing class of service of the traffic (for DPRS) or the service category of the traffic (for PORS).

You can provision frame-cell trunks to operate in HDLC mode or interrupting mode. Interrupting mode frame-cell trunks use three emission priority queues: interrupting, high, and normal. HDLC mode frame-cell trunks have two queues: high and normal. The interrupting queue has the highest priority, while the normal queue has the lowest.

For DPRS traffic, you provision the FRUNI TP with a routing class of service attribute. Each RCOS attribute has a specified emission priority (EP=0 for multimedia, EP=1 for delay, and EP=2 for throughput). The RCOS emission priority determines how the DPRS traffic will be handled on the frame-cell trunk.

On frame-cell trunks in HDLC mode, multimedia and delay traffic use the high priority queue, while throughput traffic uses the normal priority queue. On frame-cell trunks in interrupting mode, multimedia and delay traffic get split out such that multimedia uses the higher priority interrupting queue, and delay uses the high priority queue. Throughput traffic uses the normal priority queue.

Table 7, “Mapping between FRUNI TP and frame-cell trunk emission priority queue,” (page 125) provides an outline of the association between DPRS transfer priority and the frame-cell trunk emission priority.

Table 7
Mapping between FRUNI TP and frame-cell trunk emission priority queue

FRUNI TP	DPRS routing class of service (RCOS)	HDLC mode frame-cell trunk emission priority	Interrupting mode frame-cell trunk emission priority
TP 15	Multimedia (EP = 0)	High	Interrupting
:	Delay (EP = 1)		High
TP 0	Throughput (EP = 2)	Normal	Normal

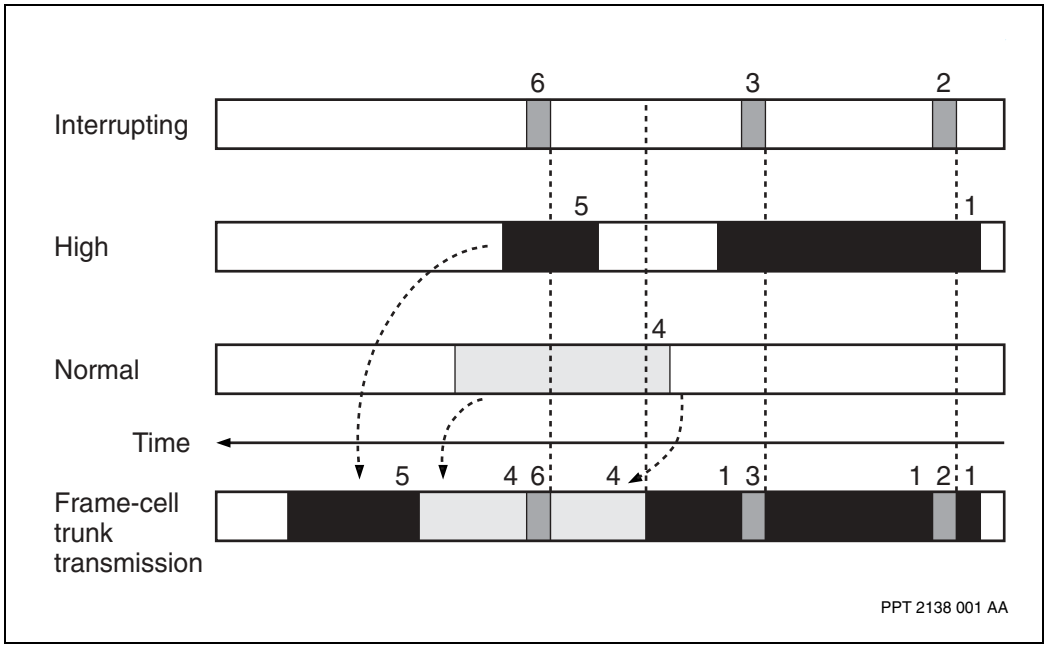
For more information on provisioning the FRUNI TP and routing class of service see NN10600-901 *Nortel Networks Multiservice Switch 7400/15000/20000 Frame Relay Configuration Management*.

Nortel Networks Multiservice Switch trunks handle PORS traffic in much the same manner as the DPRS traffic. The difference is that instead of provisioning a transfer priority with a routing class of service, you provision the PORS traffic with a service category that reflects the emission and discard priority required for the traffic type. See NN10600-435 *Nortel Networks Multiservice Switch 7400/15000/20000 Operations: Path-Oriented Routing System* for more details on PORS traffic.

The Multiservice Switch trunking system monitors frame-cell trunk emission queues for congestion and returns the congestion status to the forwarding tables. Remedial actions, such as re-routing traffic around congested areas, can be taken.

Each arriving packet lines up in an emission queue based on the delay priority indicator in its header. Figure 15, “Frame-cell trunk emission queues,” (page 126) shows an example of transmission from the three emission queues.

Figure 15
Frame-cell trunk emission queues



Frame-cell trunk congestion thresholds

Each queue in the Nortel Networks Multiservice Switch transmission trunking system supports four congestion levels or states: mild, moderate, heavy, and severe. Each congestion level corresponds to a threshold in terms of block count. The Multiservice Switch trunking system compares current length of each queue against the threshold values to determine its congestion level. As frames and cells are queuing, the trunk system informs the CPU when a queue has grown to a specified threshold value. When a frame or cell transfers from the ingress queue to the trunk, the trunking system compares the frame or cell discard priority with the trunk's congestion level. This comparison determines whether the queue accepts the frame or cell. In other words, the various congestion levels discard frames or cells when congestion persists.

Two sets of thresholds points exist for each congestion level. This arrangement prevents a large number of threshold interrupts if the queue length hovers close to a threshold. The set of upward thresholds is for an

increasing queue length. The set of downward thresholds is for decreasing queue length. When the queue length triggers the next congestion level by passing over an upward threshold, the congestion level only changes when the queue length has reduced below the corresponding downward threshold.

For the congestion threshold categories and the frame-cell trunk emission priority queue sizes in bytes, see Table 8, "Congestion thresholds on frame-cell trunks," (page 127).

> ***Note:*** The thresholds are converted values from number of blocks to bytes where each block is equal to 128 bytes for non-IP traffic. The block size for IP traffic is 256 bytes. For example, the first threshold (T1) on a 1536 kbit/s link is actually 347 blocks of 128 bytes which corresponds to 44416 bytes of shared RAM memory.

For more information on traffic management for frame-cell trunks, see NN10600-030 *Nortel Networks Multiservice Switch 7400/15000/20000 Overview*.

Table 8
Congestion thresholds on frame-cell trunks

Link speed	Emission priority	Upward thresholds (bytes)				Downward thresholds (bytes)			
		T1	T2	T3	T4	T1	T2	T3	T4
64 kbit/s	Normal	3968	8832	12416	14848	2688	7552	12416	13568
	High	2048	4352	6016	7296	1280	3456	5248	6528
	Interrupt	1024	2048	2944	3584	640	1664	2560	3200
256 kbit/s	Normal	6144	16128	22144	25984	4608	13824	20608	24576
	High	3072	7296	10496	12672	2048	6272	9600	11648
	Interrupt	1408	3456	4992	6144	1024	2944	4608	5632
384 kbit/s	Normal	8064	20992	30592	35968	6272	19328	28928	34304
	High	3840	9728	14336	17280	2816	8704	13312	16256
	Interrupt	1792	4480	6784	8320	1280	4096	6272	7808

(Sheet 1 of 2)

Table 8 (continued)
Congestion thresholds on frame-cell trunks

Link speed	Emission priority	Upward thresholds (bytes)				Downward thresholds (bytes)			
		T1	T2	T3	T4	T1	T2	T3	T4
512 kbit/s	Normal	9984	26880	39168	45696	7936	24960	37248	44032
	High	4736	12416	18304	21888	3584	11264	17152	20864
	Interrupt	2176	5760	8704	10624	1664	5632	8064	10112
1024 kbit/s	Normal	17536	49920	73216	85504	14464	47104	70528	82944
	High	8064	22784	34048	40704	6400	21248	32512	39296
	Interrupt	3712	10496	16128	19584	2944	9856	15360	18944
1536 kbit/s	Normal	44416	67456	100224	111232	42368	65280	97792	108672
	High	21120	31488	46464	51456	19072	29312	44032	48896
	Interrupt	11264	16256	23552	25984	9216	14080	21120	23424
1920 kbit/s	Normal	45056	68352	101376	112640	42624	65664	98432	109440
	High	21760	32512	47616	52864	19328	29824	44672	49664
	Interrupt	11904	17152	24704	27392	9472	14464	21760	24192
T3	Normal	78976	118528	175872	195584	69120	106624	160000	177792
	High	40448	12416	90112	100352	35456	54656	82048	91136
	Interrupt	29440	29440	48640	48640	26496	26496	44160	44160
E3	Normal	78976	118528	176872	195584	69120	106624	160000	177792
	High	40448	12416	90112	10352	35456	54656	82048	91136
	Interrupt	29440	29440	48640	48640	26496	26496	44160	44160

(Sheet 2 of 2)

Dynamic Multiservice Switch trunk speed change for frame-cell trunks

The dynamic Nortel Networks Multiservice Switch trunk speed change feature enables Multiservice Switch trunking and routing to adapt to changes in bandwidth without taking trunks out of service. The Multiservice Switch trunking system reacts to dynamic bandwidth changes and propagates this information to the routing system. The routing system uses this data to

redistribute traffic to continue delivering quality of service while simultaneously optimizing network resources. For provisioning information, see "Configuring ISDN dial backup" (page 30), "Configuring scheduled ISDN BWoD" (page 32), "Configuring alarms for dynamic ISDN BWoD" (page 34), "Configuring ISDN dial backup with scheduled BWoD" (page 35), or "Configuring ISDN dial backup with dynamic BWoD" (page 37).

This section includes the following information:

- "Dynamic Multiservice Switch trunk speed change feature highlights" (page 129)
- "ISDN dial backup" (page 130)
- "ISDN dynamic bandwidth on demand" (page 132)
- "Inverse multiplexing" (page 134)

Dynamic Multiservice Switch trunk speed change feature highlights

The dynamic Nortel Networks Multiservice Switch trunk speed change feature enables a Multiservice Switch system to interwork with third-party equipment to offer the following functionality:

- "ISDN dial backup" (page 130)

  This functionality resumes connectivity between two Multiservice Switch nodes when a leased line failure occurs.

- "ISDN dynamic bandwidth on demand" (page 132)

  ISDN dynamic BWoD enables a Multiservice Switch node to adapt to additional bandwidth when the capacity of the dedicated facility is exceeded.

- "Inverse multiplexing" (page 134)

  Inverse multiplexing enables a Multiservice Switch trunk to support more than four physical connections between adjacent Multiservice Switch nodes

V.11, V.35, and HSSI interfaces for frame-cell trunks support these third-party devices.

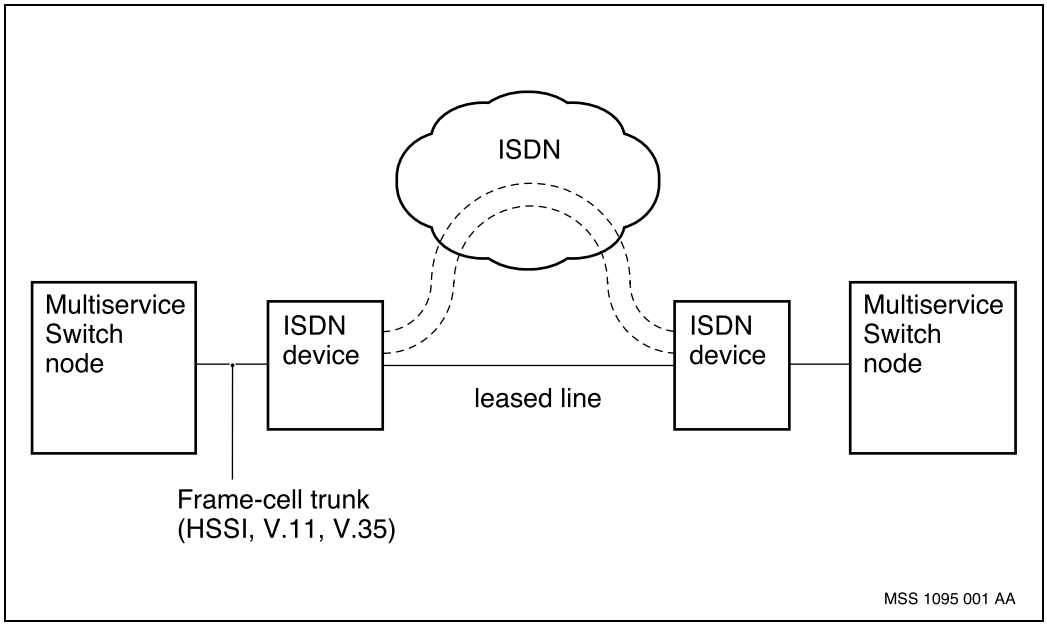
ISDN dial backup

For normal conditions, network traffic travels across a leased line. When the leased line fails, third-party ISDN equipment establishes a dialed-up connection as backup to carry the network traffic. See Figure 16, "Frame-cell trunking with third-party ISDN devices," (page 131).

In most cases, dial backup lines provide less bandwidth than the normal leased line. During these periods, the Nortel Networks Multiservice Switch network routes traffic with respect to the decreased bandwidth of the backup lines. Later, when the leased line becomes available again, third-party ISDN equipment releases the dialed-up connections, and the Multiservice Switch network routes traffic with respect to the leased line bandwidth.

Note: The Multiservice Switch node port connected to the third-party IDSN device must be set to DTE.

Figure 16
Frame-cell trunking with third-party ISDN devices



Provisioning ISDN dial backup on a Multiservice Switch 7400 series node

In the ISDN dial backup application, the Nortel Networks Multiservice Switch trunk speed change reporting mechanism is enabled. The Multiservice Switch trunk propagates speed variations to the routing systems.

When the leased line fails, the Multiservice Switch trunk either disables and re-enables with a small amount of bandwidth or learns of a sudden bandwidth decrease. The trunk reports the speed decrease immediately to the routing system. The routing system reacts to the speed decrease as soon as possible to avoid severe traffic congestion.

You can program the ISDN devices to automatically dial up a given number of lines at a time. In these cases, the dialed-up speed increases in steps. To avoid these transient speed updates from overloading the routing system, the Multiservice Switch trunk speed change reporting mechanism allows you to customize the granularity and the frequency of the speed increase updates.

Reporting speed changes: The dynamic Multiservice Switch trunk speed change feature has seven provisionable threshold levels for reporting the speed changes. In the ISDN dial backup application, the Multiservice Switch trunk runs in one of two modes: normal speed and backup speed.

If only the normal speed provided by the leased line and one backup speed is provisioned as the threshold level, the Multiservice Switch trunk reports the following speed increase to the routing system:

- when it has obtained the expected backup speed
- when it has obtained the normal speed provided by the leased line

The Multiservice Switch trunk reports the current measured speed to the routing system if the next threshold level to the last reported speed, or the expected normal speed is reached and remains above that level after the hold-off time.

ISDN dynamic bandwidth on demand

To provide extra bandwidth for traffic peaks, dynamic bandwidth on demand (BWoD) is a more cost-efficient alternative than configuring extra bandwidth permanently. By dialling up extra bandwidth in response to high traffic levels, network planners and engineers can reduce facility cost.

As seen in Figure 16, “Frame-cell trunking with third-party ISDN devices,” (page 131), the frame-cell trunk bandwidth dynamically increases as the third-party ISDN devices dial up more connections. The dynamic increases can be

- “Dynamic increases—scheduled ISDN BWoD” (page 132)
- “Dynamic increases—dynamic ISDN BWoD” (page 133)

Dynamic increases—scheduled ISDN BWoD

In this configuration, extra bandwidth is required on a frame-cell trunk on a planned basis to respond to an anticipated peak in user traffic. For example, a particular application using the network can generate low levels of interactive traffic most of the time, but need to transfer large amounts of data from one host site to another on a daily basis for backup or consolidation purposes. To

respond to this requirement, the third-party devices are set up to automatically dial up extra bandwidth between the two sites involved for the scheduled duration of the large data transfer.

When the scheduled BWoD occurs, the Multiservice Switch network routes a higher volume of traffic through the frame-cell trunk where the bandwidth has been increased for that period of time. When the Multiservice Switch network releases the extra dialed up bandwidth, the traffic over the frame-cell trunk returns to the reduced volume of traffic.

Dynamic increases—dynamic ISDN BWoD

If the traffic volumes vary widely in an unpredictable manner, frame-cell trunk congestion can occur during traffic peaks.

Through the third-party devices, the network can monitor traffic patterns and volumes and dynamically dial up extra bandwidth in response to traffic peaks.

If the third-party ISDN devices enable dynamic BWoD, the frame-cell trunk gets extra bandwidth to avoid or relieve congestion. If there is enough added bandwidth (as a percentage) the metric can be adjusted downward and the frame-cell trunk attracts more traffic.

Provisioning scheduled ISDN BWoD on a Multiservice Switch 7400 series node

In the scheduled ISDN BWoD application, the Multiservice Switch trunk speed change reporting mechanism is enabled. The Multiservice Switch trunk propagates speed variations to the routing systems.

You can program the ISDN devices to automatically dial up a given number of lines at a time. In this application, the speed increases in steps. To avoid transient speed updates from overloading the routing system, the Multiservice Switch trunk speed change reporting mechanism allows you to customize the granularity and frequency of the speed increase updates.

Reporting speed changes: In the scheduled ISDN BWoD application, the Multiservice Switch trunk runs in one of two modes: normal speed and peak speed. You can specify a maximum of seven values through the *speedReportingThresholds* attribute. The following procedure describes how to provision two thresholds (the expected speed of the leased line and the expected peak speed).

Provisioning ISDN dial backup with scheduled BWoD on a Multiservice Switch 7400 series node

In this application, the Multiservice Switch trunk speed change reporting mechanism is enabled. The Multiservice Switch trunk propagates speed variations to the routing systems.

Reporting speed changes: In the ISDN dial backup with scheduled BWoD application, the Multiservice Switch trunk runs in one of three modes: normal speed, peak speed, or backup speed. Provision the expected backup speed, expected speed of leased lines, and the expected peak speed as the threshold values.

Multiservice Switch trunks report only three speed increases to the routing system:

- when it has obtained the expected backup speed
- when it has obtained the normal speed provided by the leased line
- when it has obtained the expected peak speed

You can provision a maximum of seven threshold values for the *speedReportingThresholds* attribute.

Inverse multiplexing

Before inverse multiplexing, a maximum of four frame-cell trunks between Nortel Networks Multiservice Switch nodes were supported. If there was a requirement for more bandwidth than four DS1/E1 frame-cell trunks could provide, a DS3/E3 facility had to be installed between two Multiservice Switch nodes. Now, inverse multiplexing supports cost-efficient configurations with multiples in excess of four DS1/E1 frame-cell trunks between two Multiservice Switch nodes. There are two solutions provided for inverse multiplexing configurations:

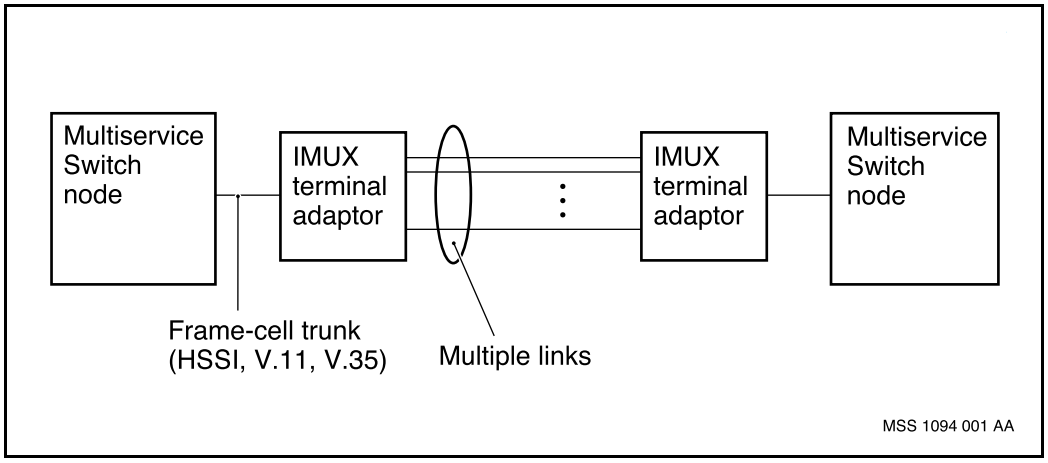
- “Inverse multiplexing on a Multiservice Switch 7400 series node” (page 150)
- “Third-party inverse multiplexing (IMUX) for frame-cell trunks” (page 135)

Third-party inverse multiplexing (IMUX) for frame-cell trunks

This configuration provides flexibility to the network provider when it is necessary to use third-party IMUX devices. The frame-cell trunk has the entire bandwidth of the IMUX as shown in Figure 17, "Frame-cell trunking with third-party IMUXs," (page 135).

If third-party equipment detects additional or fewer links between the IMUXs, the third-party IMUX adjusts its clock which it provides to the Multiservice Switch node to reflect the bandwidth changes. The bandwidth updates can then be propagated to the routing systems, which in turn takes the appropriate rerouting actions.

Figure 17
Frame-cell trunking with third-party IMUXs



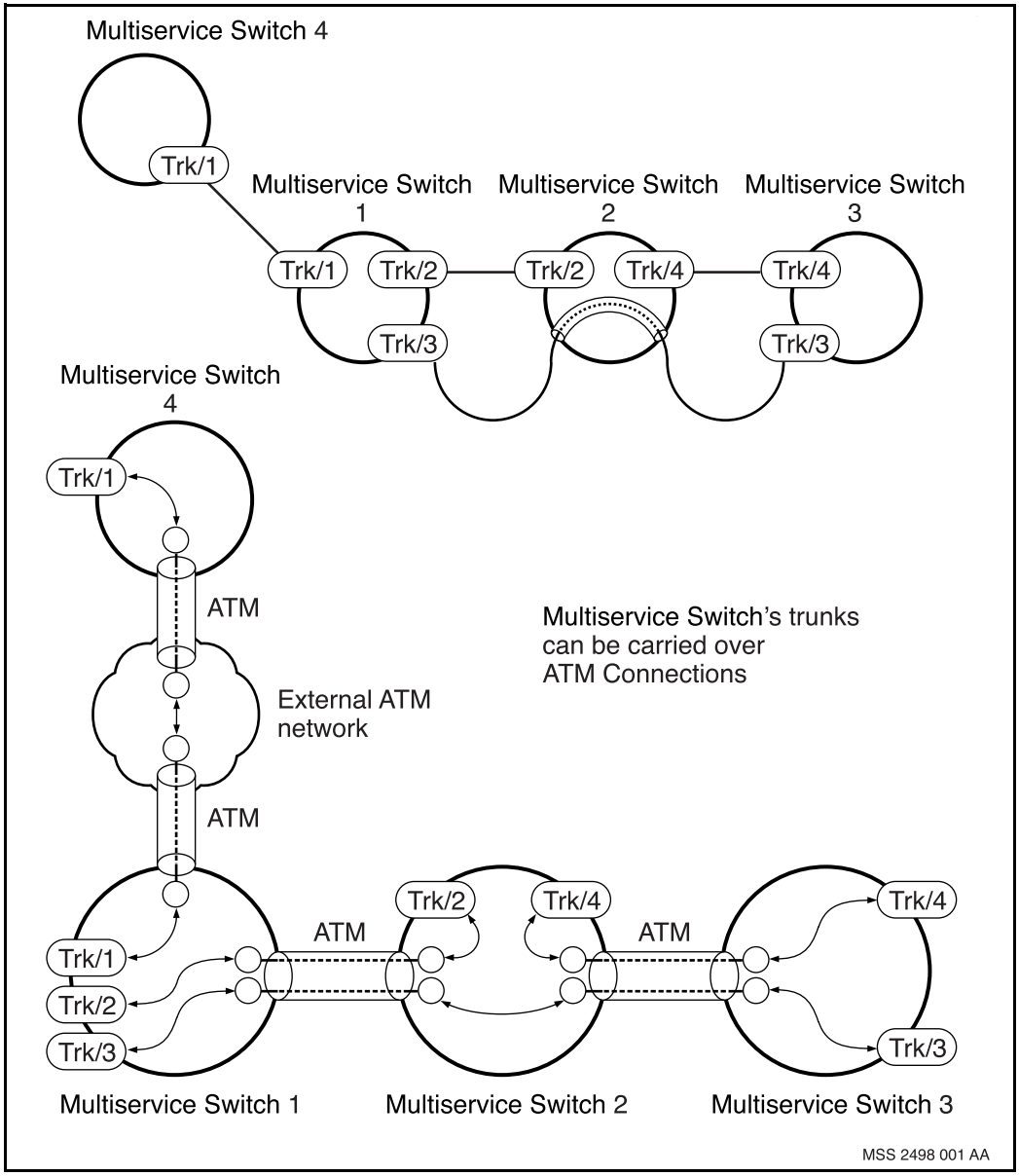
Chapter 9
Multiservice Switch trunks over ATM

Nortel Networks Multiservice Switch trunks over ATM logically interconnect Multiservice Switch nodes over ATM facilities as shown in Figure 18, "Multiservice Switch trunks over ATM," (page 138). This design offers the ability to map many trunks onto one ATM pipe in a point-to-point manner. This mapping is done by replacing the physical medium of traditional frame-cell trunks by an ATM VCC. A single interface (or port) can support multiple VCCs. Multiservice Switch trunks over ATM allows all existing services to be carried. This transport mechanism also enables new service offerings to be carried prior to standardization of future adaptation protocols.

This section describes the following Multiservice Switch trunks over ATM information:

- "Configuring Multiservice Switch trunks over ATM" (page 139)
- "Multiservice Switch trunks over ATM connection administration" (page 144)
- "Traffic management for Multiservice Switch trunks over ATM" (page 146)
- "Dynamic trunk speed change on Multiservice Switch trunks over ATM" (page 150)
- "Engineering considerations for Multiservice Switch trunks over ATM" (page 155)

Figure 18
Multiservice Switch trunks over ATM



Configuring Multiservice Switch trunks over ATM

You can implement Nortel Networks Multiservice Switch trunks over ATM using a variety of VCC configurations. These VCC configurations define whether the trunk is logical or direct. A logical trunk uses a VCC which in itself is a concatenation of VCC segments. A direct trunk uses a single VCC segment between two adjacent Multiservice Switch nodes. These configurations include

- "Direct Multiservice Switch trunks over ATM" (page 139)
- "Logical trunking over a Multiservice Switch ATM network" (page 139)
- "Logical trunking over an external ATM network" (page 142)

Direct Multiservice Switch trunks over ATM

Direct trunking between Nortel Networks Multiservice Switch nodes involves defining a Multiservice Switch trunk over a VCC on an ATM facility that directly connects two nodes (see Figure 19, "Direct and logical trunking over a Multiservice Switch ATM network," (page 141)). Each VCC endpoint is located on the nodes at each end of the ATM facility. Therefore, only a single VCC segment is necessary to define the Multiservice Switch trunk.

This way of interconnecting Multiservice Switch nodes over ATM is the simplest to deploy. This setup only requires a replacement of the existing frame-cell point-to-point trunks with equivalent Multiservice Switch trunks over ATM.

Traffic transfers to the software level at each tandem hop along the path to the destination. Unlike logical trunking (see "Logical trunking over a Multiservice Switch ATM network" (page 139) for more information), direct Multiservice Switch trunks over ATM do not take advantage of the ATM hardware forwarding capabilities of Multiservice Switch nodes.

If you provision the Multiservice Switch trunks for map mode, PORS paths use hardware forwarding. See "Map mode" (page 169).

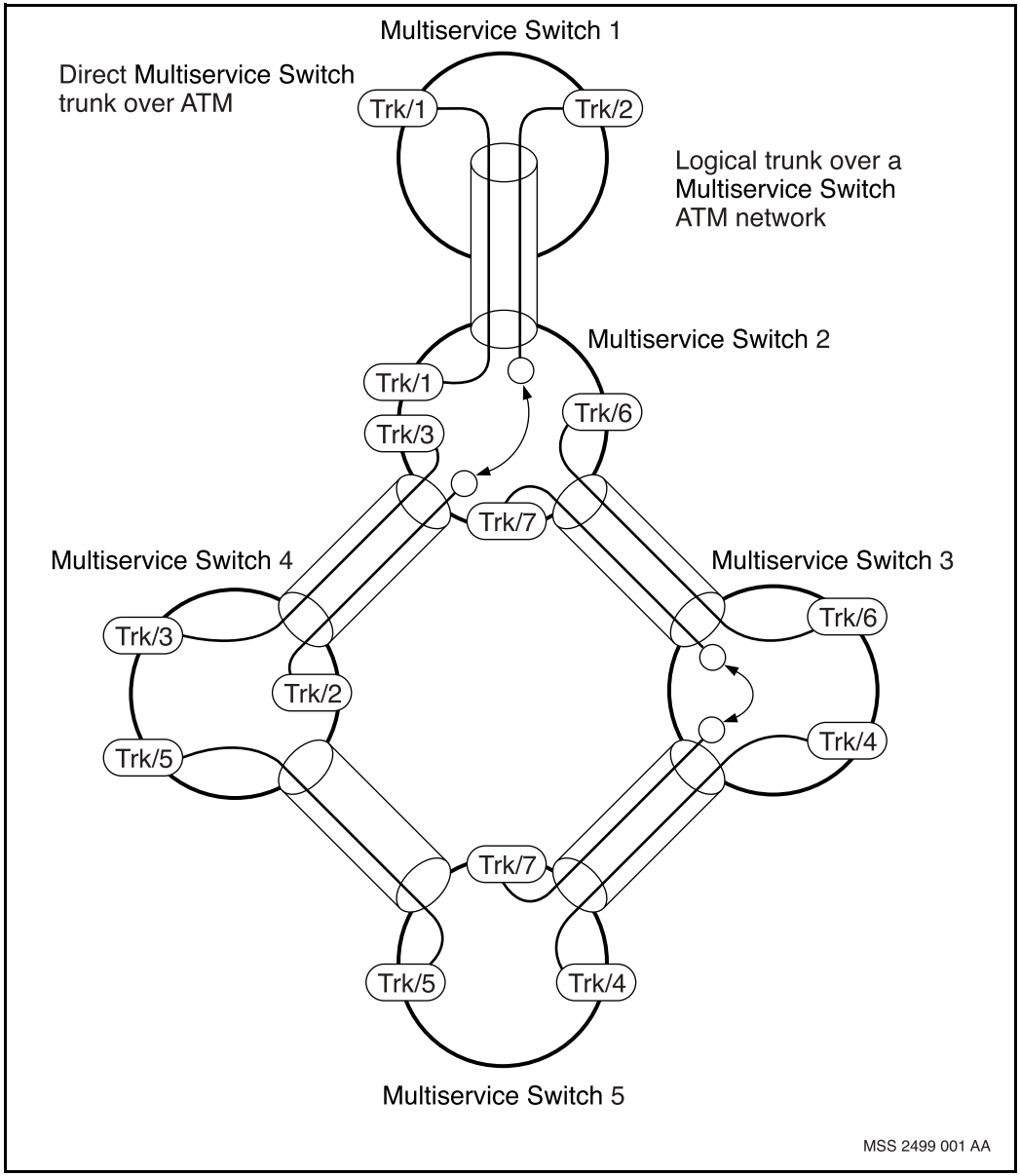
Logical trunking over a Multiservice Switch ATM network

Logical trunking over a Nortel Networks Multiservice Switch ATM network involves defining a Multiservice Switch trunk over an ATM bearer service that passes through one or more intermediary Multiservice Switch nodes. See

Figure 19, “Direct and logical trunking over a Multiservice Switch ATM network,” (page 141). The ATM bearer service consists of an ATM VCC with nailed up relay points defined at tandem nodes along the path between the source and destination of the VCC. A single interface can support multiple Multiservice Switch trunks over ATM to provide connectivity to multiple remote Multiservice Switch nodes.

If you use this logical trunking configuration, you can achieve the full benefits of ATM through the use of ATM hardware forwarding at each of the tandem hops of the Multiservice Switch trunk. This configuration effectively provides a cut-through mechanism at the tandem nodes along the VCC of the logical trunk which can significantly improve performance at these tandem hops.

Figure 19
Direct and logical trunking over a Multiservice Switch ATM network



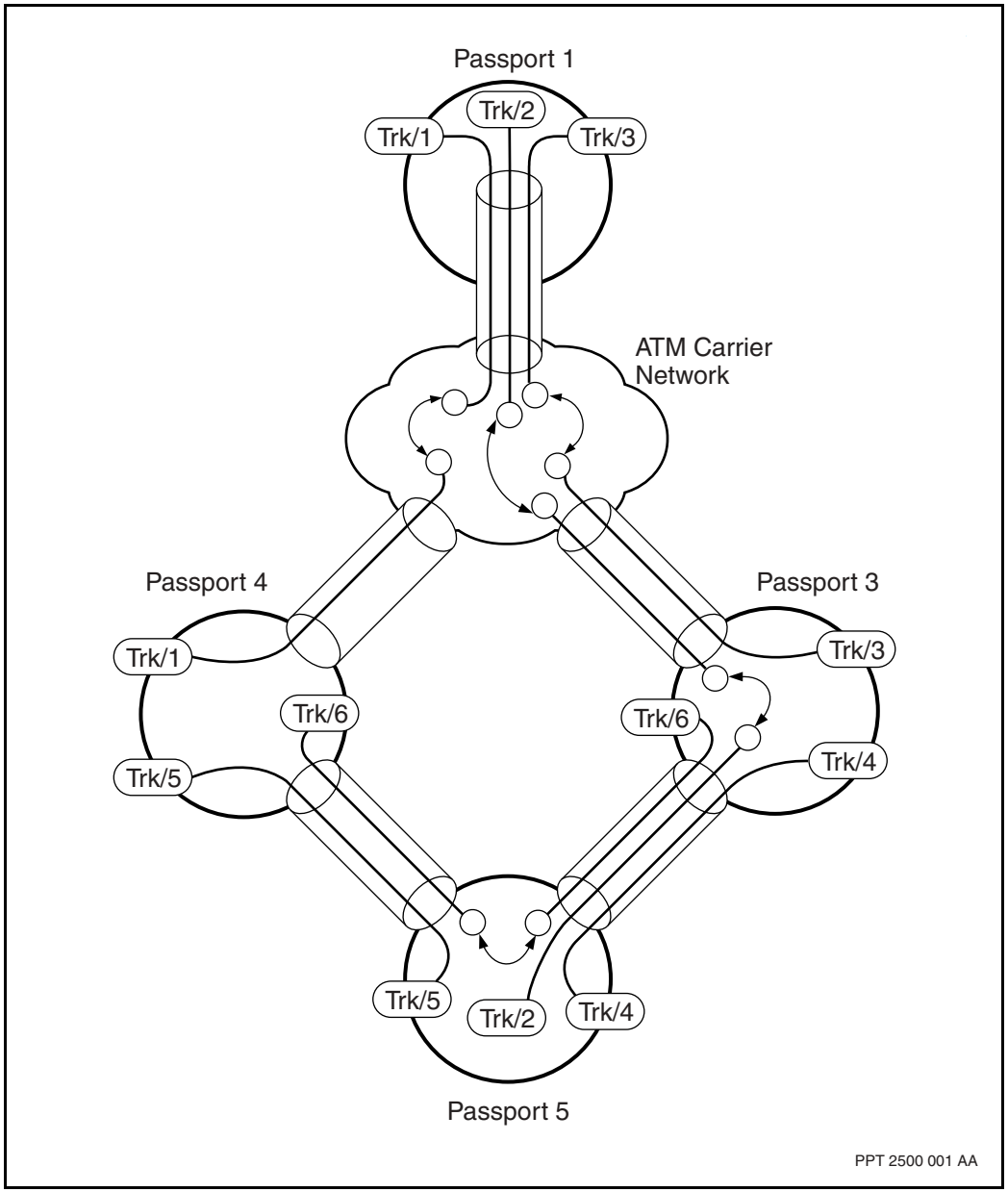
Logical trunking over an external ATM network

In a Nortel Networks Multiservice Switch trunks over ATM scenario with an external ATM network, the logical trunks are on ATM connections that run through an external ATM network. See Figure 20, “Logical trunking over an external ATM network,” (page 143). The external ATM network views the Multiservice Switch nodes as customer premise equipment (CPE). An ATM UNI connection to the third-party network is necessary. Multiple Multiservice Switch trunks over ATM can be supported on a single interface to provide connectivity to multiple remote Multiservice Switch nodes.

For Multiservice Switch trunks over ATM across an external ATM network, consider that the external ATM network can have usage parameter control (UPC) turned on at the interface. Ensure that traffic meets the ATM traffic contract guarantee of no loss of traffic at the ingress point to the ATM network. This guarantee can be achieved through the use of traffic shaping on the Multiservice Switch trunk VCC. For more information see “Traffic management for Multiservice Switch trunks over ATM” (page 146).

For the trunk to stage, the external network must set an appropriate cell delay-variance tolerance (CDVT) value.

Figure 20
Logical trunking over an external ATM network

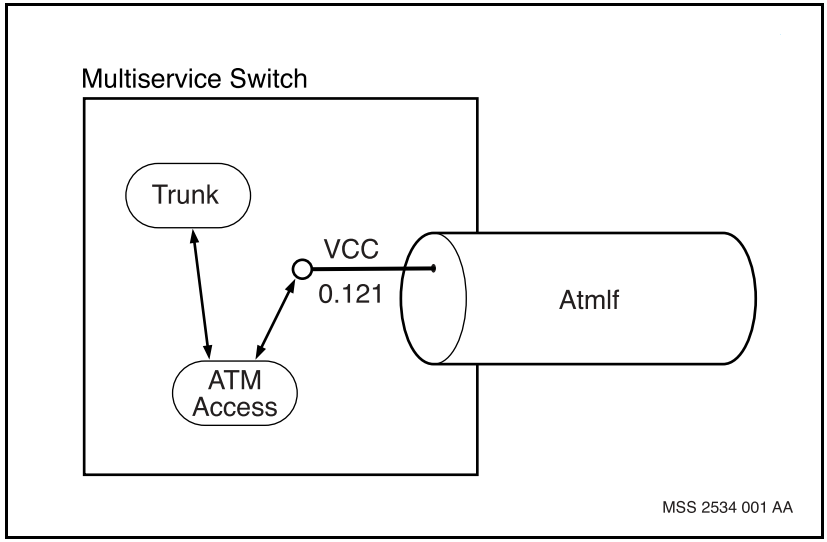


Multiservice Switch trunks over ATM connection administration

For the ATM switching layer to interwork properly with the network layer, the switching layer needs to relay the connection administration information to the network layer.

The *AtmAccess* component links Nortel Networks Multiservice Switch trunks over ATM to ATM VCCs. See Figure 21, "Multiservice Switch trunks over ATM connection administration," (page 144).

Figure 21
Multiservice Switch trunks over ATM connection administration



The *AtmAccess* component controls the following functions for the trunk:

- provides the logical linking point for the ATM connection.

  This component provides to its parent *Trunk* component an anchor point for the logical link to the *Vcc* component. The Vcc component can be associated with an *AtmInterface* component or a *VirtualPathTerminator* component.

- provides a mechanism to relay VCC configuration information to the *Trunk* component

  When a *Trunk* component links to an ATM VCC using the *AtmAccess* component, the *AtmAccess* component forwards VCC configuration information from the VCC to the *Trunk* component.

- provides provisioning access

  Any provisioning change to the *atmConnection* attribute of the *AtmAccess* component results in the Multiservice Switch trunk disabling and restaging. Changes to bandwidth attributes of a VCC result in the VCC going to disabled status and the Multiservice Switch trunk disabling. On restoration of the VCC to enabled status, the Multiservice Switch trunk restages and reports the new bandwidth availability to the routing system.

- reports available bandwidth to the *Trunk* component

  The AtmAccess component relays the available bandwidth of the ATM switching layer to the *Trunk* component. The *AtmAccess* component calculates the bandwidth available to the Multiservice Switch trunk by converting the transmit cell rate of its VCC to a form recognized by Multiservice Switch trunks. Depending on the value of the *AtmAccess* attribute *vccReportingBw*, the cell rate can be either

  — the peak cell rate (PCR) or current cell rate (CCR)

  — the actual cell rate (ACR)

The unit of measurement for PCR is cells per second (cells/s) but the Multiservice Switch trunk and topology systems work in bandwidth units of bits per second (bps). The *AtmAccess* component converts the PCR value to a bandwidth value measured in bits/s using the conversion formula of 1 cell/s = 384 bit/s. The reported VCC bandwidth is indicated by the value of the trunk attribute *measuredSpeedToIf*.

- relays status information

  While the VCC is in operation, the *AtmAccess* component indicates to the Multiservice Switch trunk if the status of the VCC changes from enabled to disabled. A Multiservice Switch trunk status can be either up

or down, that is, a Multiservice Switch trunk that is up is operating as intended, while a Multiservice Switch trunk that is down is not functioning at all.

You can determine the status of the ATM connection in several ways depending on the type of failure. In the case of an interface failure at the ATM port, all VCCs on the port are down. As well, an ATM connection can also be down because of network or remote end problems. You can detect these problems by the alarm indication signal/remote defect indication (AIS/RDI) or loopback functions provided by the ATM layer.

When an RDI or AIS OAM cell arrives at the terminating connection (Multiservice Switch trunk connections are always terminating) or if loopbacks fail, the *AtmAccess* component receives the failure notification and relays it to the Multiservice Switch trunk as a connection failure. Therefore, it is preferable that you provision VCCs used by Multiservice Switch trunks with end-to-end loopback enabled.

Note: If you provision a Multiservice Switch trunk VCC on an ATM interface or under a virtual path terminator that is connected to an external ATM network, and end-to-end loopback is enabled, the VCC can become disabled.

- relays delay information

  Multiservice Switch trunks measure round-trip delay (RTD) during the discovery phase of the Multiservice Switch trunk staging protocol. Multiservice Switch trunks calculate RTD in microseconds then round to the nearest 100 microseconds. Routing calculates all delay metrics using this delay value in 100s of microseconds. Trunking and routing attributes are displayed in milliseconds with one decimal point.

Traffic management for Multiservice Switch trunks over ATM

Nortel Networks Multiservice Switch ATM networks can support many applications, such as voice, video, multimedia, file transfer, and interactive communication. Each application has unique traffic characteristics (in terms of rate and density variation) and performance needs (in terms of cell-frame

delay and cell loss). The applications used define the service requirements for each subscriber. The communication needs of these applications can be translated into a set of traffic characteristics based on the required quality of service (QoS) classes and the traffic descriptor types. Traffic management functions help ensure that the QoS objectives for each subscriber are met. Traffic management must also maximize the service provider's use of network resources so that the service offering is cost effective.

Traffic management topics introduced in this section include:

- "Usage parameter control (UPC)" (page 147)
- "Traffic shaping" (page 148)
- "Emission priority" (page 148)
- "Congestion indication" (page 149)

For more information on traffic management, see:

- "Traffic management for frame-cell trunks" (page 124)
- NN10600-030 *Nortel Networks Multiservice Switch 7400/15000/20000 Overview*
- NN10600-920 *Nortel Networks Multiservice Switch 7400/15000/20000 Operations: Frame Relay to ATM Interworking*
- NN10600-705 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Traffic Management Fundamentals*

Usage parameter control (UPC)

UPC is the set of actions taken by the network to monitor and control traffic, in terms of both the traffic offered and the validity of the ATM connection at the end-system access. The main purpose of UPC is to protect network resources from traffic demands in excess of those defined through the traffic contract, which can affect the QoS of established connections. UPC detects violations of negotiated parameters and takes appropriate actions, such as cell tagging and cell discarding.

Traffic shaping

Traffic shaping smooths-out traffic bursts. This traffic management strategy regulates the emission interval of cells in the transmit direction. Traffic shaping is useful for ensuring conformance of transmitted traffic to subscribed traffic parameters, or to ensure conformance at a subsequent interface. Traffic shaping is recommended when connecting to an external ATM network, where the connection can be policed.

Emission priority

Traffic management for Nortel Networks Multiservice Switch trunks over ATM also includes the emission priority system. The single virtual channel implementation enables all traffic types to flow through a single ATM emission queue.

Multiservice Switch trunks over ATM handle traffic according to the emission priority of the VCC to which the trunk is provisioned. Each Multiservice Switch trunk over ATM is provisioned to a VCC. On ATM FPs, each VCC has a service category (CBR, VBRrt, VBRnrt) with a specified emission priority of high, medium or low. On ATM IP function processors, the emission priority of the service category is provisionable, and can be assigned any of eight emission priorities from EP0 (high) to EP7 (low). For details on the carriage of frame relay traffic over ATM see NN10600-920 *Nortel Networks Multiservice Switch 7400/15000/20000 Operations: Frame Relay to ATM Interworking*. For details on ATM traffic management for ATM IP and CQC function processors see NN10600-705 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Traffic Management Fundamentals*.

Multiple emission priorities provide the proper emission requirements for different traffic types. Voice traffic, for example, has strict emission delay requirements of less than 20 milliseconds. For trunks running the equivalent of E3 rates and below, the voice traffic must have a higher emission priority than data. This priority ensures there are no unacceptable emission delays due to voice frames being queued behind long or multiple data frames.

Multiservice Switch trunks over ATM have a single emission queue, capable of carrying both DPRS data traffic and isochronous traffic such as HTDS, voice, and BTDS on the same trunk. This can result in the delay requirements of the isochronous traffic not being met. This problem can occur due to queueing delay if the data rate is low, or if large frames are present, or both.

Engineering the Multiservice Switch trunk service category and the number of Multiservice Switch trunks, or both provides the proper emission requirements for various traffic types. Sometimes the emission requirements for isochronous traffic cannot be met on a single ATM connection. If the requirements cannot be met, different traffic types can be divided over two or more ATM connections, each of which you can provision with an appropriate quality of service. For example, you can provision one Multiservice Switch trunk over ATM with a service category that specifies only data traffic, while you can provision a second one with the service category that specifies only higher priority real-time traffic (such as voice service and BTDS).

Note: Multiservice Switch trunks over ATM do not support unspecified bit rate (UBR), the default ATM service category on Multiservice Switch nodes. For a description of the ATM service categories available on Multiservice Switch nodes, see NN10600-715 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Fault and Performance Management*.

Congestion indication

Nortel Networks Multiservice Switch also forwards congestion indication from ATM traffic to Multiservice Switch trunk traffic using explicit forward congestion indication and forward congestion indication (EFCI-FCI) mapping.

Mapping occurs when an incoming AAL5 frame is being reassembled and at least one of its cells contains an EFCI indication. The Multiservice Switch trunk sets the FCI bit in the Multiservice Switch packet, if the bit needs to be set. Mapping occurs automatically and requires no provisioning.

Dynamic trunk speed change on Multiservice Switch trunks over ATM

The dynamic Nortel Networks Multiservice Switch trunk speed change feature is supported on Multiservice Switch 7400 series nodes only. Multiservice Switch 15000 and Multiservice Switch 20000 nodes do not support this feature.

The dynamic Multiservice Switch trunk speed change feature enables Multiservice Switch trunking and routing to adapt to changes in bandwidth without taking trunks out of service. For the frame-cell feature description, see "Dynamic Multiservice Switch trunk speed change for frame-cell trunks" (page 128). For provisioning information, see "Dynamic Multiservice Switch trunk speed change for frame-cell trunks" (page 128).

This feature also supports Multiservice Switch trunking on the integrated Inverse Multiplexing for ATM (IMA). For details on IMA, see NN10600-730 *Nortel Networks Multiservice Switch 7400/15000/20000 Inverse Multiplexing for ATM Operations*.

Inverse multiplexing on a Multiservice Switch 7400 series node

The following solutions are provided for inverse multiplexing configurations:

- "Integrated inverse multiplexing on ATM facilities carrying Multiservice Switch trunks" (page 151)
- "Third-party inverse multiplexing (IMUX) for frame-cell trunks" (page 135)

For an introduction to inverse multiplexing see "Inverse multiplexing" (page 134). For provisioning information for the dynamic trunk speed change IMA feature, see "Provisioning a non-elastic trunk for IMA" (page 49), and "Provisioning an elastic trunk for IMA" (page 50).

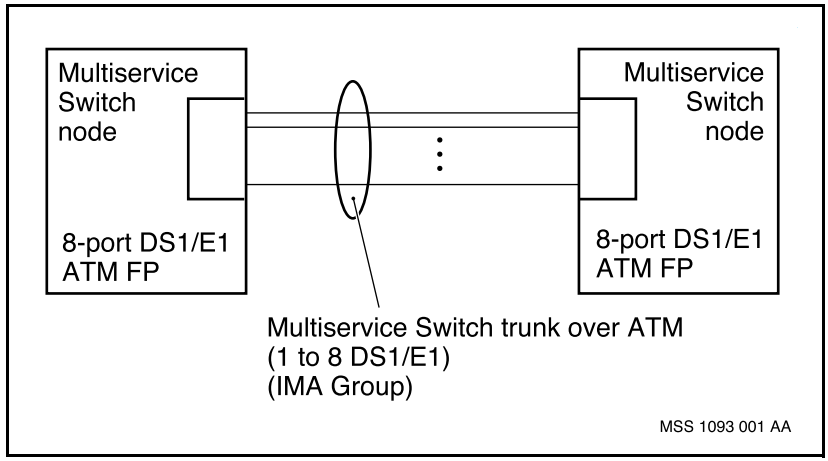
Integrated inverse multiplexing on ATM facilities carrying Multiservice Switch trunks

Nortel Networks Multiservice Switch system supports an integrated inverse multiplexing solution through the Inverse Multiplexing for ATM (IMA) feature. This feature is supported on Nortel Networks Multiservice Switch 7400 series nodes only. Multiservice Switch 15000 and Multiservice Switch 20000 nodes do not support this feature.

For a list of all FPs that support this feature, refer to NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.

Figure 22, "Multiservice Switch trunking over ATM on eight-port DS1/E1 ATM IMA FPs," (page 151) shows how eight-port DS1/E1 ATM FPs support an IMA link group. The IMA group bandwidth is the aggregate of up to eight ATM DS1/E1 physical links. Multiservice Switch series trunks over ATM that are part of the IMA link group use VCCs which share the bandwidth on the IMA group.

Figure 22
Multiservice Switch trunking over ATM on eight-port DS1/E1 ATM IMA FPs



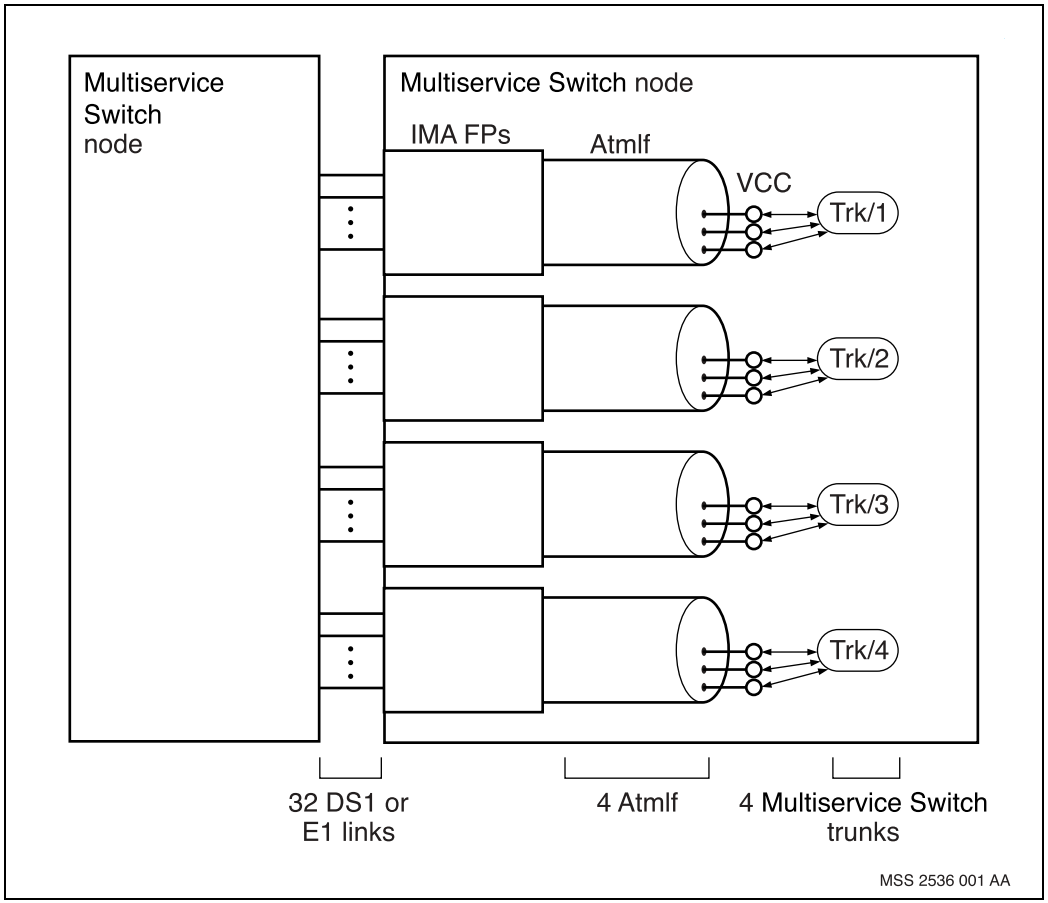
IMA technology greatly increases the number of DS1 or E1 links that can be supported between two Multiservice Switch nodes. Without IMA

- Up to four Multiservice Switch trunks are possible between two Multiservice Switch nodes.
- Each Multiservice Switch trunk runs over its own physical link.

With IMA, up to 32 physical DS1 or E1 links are possible. See Figure 23, "IMA support of links between Multiservice Switch 7400 series nodes," (page 153). This maximum number results from the following configuration:

- Four trunks each carry one or more ATM VCCs.
- Each ATM VCC is part of one of the four ATM interfaces.
- Each of four *AtmIf* components consists of eight DS1 or E1 links in an IMA group.

Figure 23
IMA support of links between Multiservice Switch 7400 series nodes



If IMA detects additional or fewer links between the IMA FPs, the IMA group bandwidth can fluctuate. The software informs the Multiservice Switch trunk of the bandwidth change. The bandwidth update can be propagated to the routing systems which in turn takes appropriate rerouting actions. PORS, and DPRS, provide dynamic bandwidth updates.

Only direct Multiservice Switch trunks over ATM composed of nailed-up single-hop permanent virtual circuits (PVCs) can be configured as bandwidth elastic connections. Elastic connections can lose and regain bandwidth in response to changes in bandwidth available over an IMA link group.

The Multiservice Switch trunking system admits a newly added non-elastic trunk at full bandwidth. The trunking system readmits a released non-elastic trunk at the full original bandwidth.

The trunking system admits a newly added elastic trunk at full or reduced bandwidth. The trunking system readmits a released elastic trunk at the full or reduced original bandwidth.

Use an elastic trunk when the connection must stay up over the IMA link even though it is susceptible to reduced bandwidth. For elastic trunks, use either PORS map mode or AAL5 mux mode. Do not use PORS SPO-mux mode on an elastic trunk. In SPO-mux mode, the connection bandwidth controller (CBC) cannot guarantee that the trunk VCCs will remain up when the IMA group experiences bandwidth reductions.

For non-elastic trunks only, a trunk is released according to the holding priority. Use non-elastic trunks when you can apply the CBC holding priority.

An elastic or non-elastic trunk can be released due to

- a critical provisioning change that affects the trunk or VCC
- a locked trunk (local or remote-end lock)
- a trunk restage due to a faulty facility

For details on how ATM connections (including elastic connections) respond to dynamic bandwidth over an IMA link group, see NN10600-700 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Technology Fundamentals* and NN10600-702 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Routing and Signalling Fundamentals*.

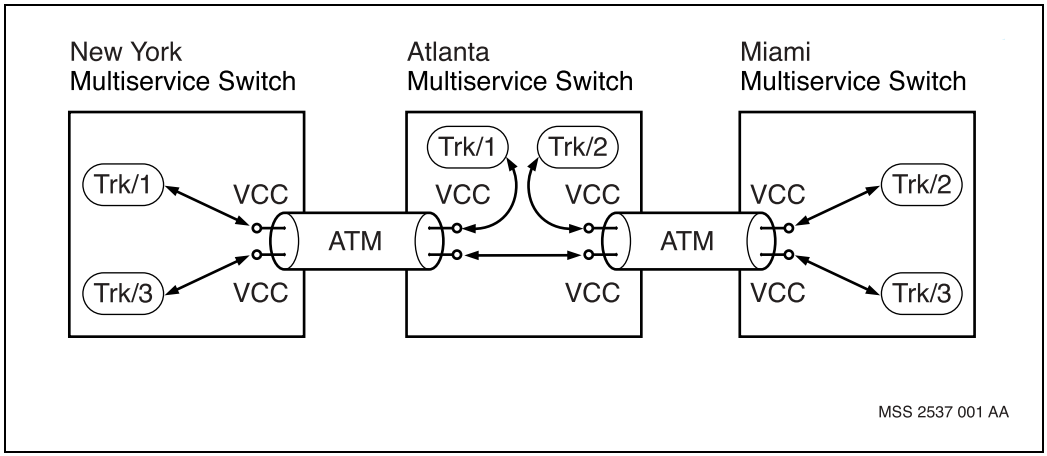
Engineering considerations for Multiservice Switch trunks over ATM

In order to maximize network efficiency, Nortel Networks Multiservice Switch trunks over ATM must be engineered with the following considerations in mind:

Maximizing connection performance

To maximize connection performance in a Nortel Networks Multiservice Switch network, increase the number of logical trunks and decrease the number of direct trunks where trunk concatenation is necessary. For a Multiservice Switch network, if you are planning to implement a logical Multiservice Switch trunk over ATM, ensure that you have concatenated the VCC links of the connection before logically linking the trunk component to the interface component (as opposed to concatenating several trunks). See Figure 24, "Increasing connection performance by using logical Multiservice Switch trunks over ATM," (page 156). In this example, the node in New York connects to Atlanta by Multiservice Switch trunk 1 and Atlanta connects to Miami by Multiservice Switch trunk 2. If you add Multiservice Switch trunk 3 to logically connect New York to Miami, you can achieve better performance between those two nodes. Traffic tandeming through Atlanta does not then go through software processing (that is, hardware cell relays it).

Figure 24
Increasing connection performance by using logical Multiservice Switch trunks over ATM



Increasing node connectivity

As illustrated in Figure 24, "Increasing connection performance by using logical Multiservice Switch trunks over ATM," (page 156), both the New York and Miami nodes have increased their number of neighbors. One benefit of this is that it provides additional redundancy. For example, if Multiservice Switch trunk 2 is disabled yet the ATM interface is still operational then the Miami node is not isolated from the network as it still has connectivity to the New York node.

Preside Multiservice Data Manager connectivity on tandem nodes

In Figure 24, "Increasing connection performance by using logical Multiservice Switch trunks over ATM," (page 156), if Nortel Networks Multiservice Switch trunk 1 and Multiservice Switch trunk 2 do not exist and the Atlanta node is only for ATM bearer service such as the tunneling of trunk 3, then the Atlanta node is not accessible for Preside Multiservice Data Manager operations through the Multiservice Switch network. To achieve connectivity, the Atlanta node too needs to have a direct connection between the Multiservice Switch node and the Preside Multiservice Data Manager workstation. Or, it requires a direct Multiservice Switch trunk over ATM (either Multiservice Switch trunk 1 or Multiservice Switch trunk 2) to connect to the Miami node.

Trunk metrics

Even though a logical trunk looks like a single hop to the routing system, the logical trunk can actually tandem through service nodes. If the associated metrics to this Nortel Networks Multiservice Switch trunk are substantially in excess of service requirements, the existing override features of the Multiservice Switch trunk can alter them.

Configuring trunks over ATM VCCs

Configuring Nortel Networks Multiservice Switch trunks over ATM to support different traffic types requires additional engineering effort because each Multiservice Switch trunk over ATM offers one emission priority. To achieve different emission priorities over Multiservice Switch trunks over ATM within a given trunk group (that is a pair of connected Multiservice Switch nodes), each Multiservice Switch trunk over ATM must use a different VCC providing a different ATM service category.

For a more detailed explanation on these configurations, see the *Nortel Networks Multiservice Switch Release Notes*.

Multiservice Switch trunks over ATM bandwidth

The *AtmAccess* attribute *vccReportingBw* determines how the bandwidth of a VCC is reported to the parent Nortel Networks Multiservice Switch trunk:

- If its value is pcr (the default value), the PCR or current cell rate (CCR) is reported.
- If its value is acr, the best measurement of the actual cell rate (ACR) is reported. The ACR is the minimum of the PCR, CCR, and actual shaping rate (ASR).

The actual reported bandwidth also depends on other factors:

- whether there is a requested shaping rate (RSR) in effect
- whether traffic shaping is in effect
- whether elastic bandwidth has been provisioned for the Multiservice Switch trunk

Table 9, “ATM factors and reported cell rate,” (page 158) shows the relationships between these factors and the value of the reported cell rate. When the *vccReportingBw* attribute is set to pcr, the VCC reported bandwidth is either PCR or CCR. The CCR is reported when the VCC bandwidth is reduced below the PCR. When the *vccReportingBw* attribute is set to acr, the minimum of the PCR, CCR, or ASR is reported. The actual cell rate is never higher than the PCR. When traffic shaping is in effect, the ASR is shaped at the next rate lower than the PCR, CCR, or RSR.

Table 9
ATM factors and reported cell rate

Factor	**Value**							
RSR	N	N	N	N	Y	Y	Y	Y
trafficShaping	N	N	Y	Y	N	N	Y	Y
bwElastic	N	Y	N	Y	N	Y	N	Y
Reported cell rate when vccReportingBw=pcr	PCR	PCR/ CCR	PCR	PCR/ CCR	PCR	PCR/ CCR	PCR	PCR/ CCR
Reported cell rate when vccReportingBw=acr	PCR	PCR/ CCR	min. of PCR, ACR	min. of PCR/ CCR, ASR	PCR	PCR/ CCR	min. of PCR, ACR	min. of PCR/ CCR, ASR

Chapter 10
Multiservice Switch routing over ATM

You can adapt all of Nortel Networks Multiservice Switch nodes' non-ATM services to ATM using Multiservice Switch trunks over ATM. This functionality is achieved by taking advantage of the existing Multiservice Switch node routing architecture. ATM networks using DPRS, and PORS on Multiservice Switch trunks over ATM can carry all Multiservice Switch non-ATM services. Multiservice Switch nodes also allow a smooth migration toward ATM by allowing the co-existence and interworking of frame-based and ATM-based trunks.

For some PORS services on Multiservice Switch trunks over ATM, you can achieve additional high performance end-to-end through hardware forwarding along the ATM path of the connection. For example, Multiservice Switch nodes deliver an end-to-end high-speed voice over ATM solution by using the ATM hardware to adapt and switch voice traffic through the ATM function processor (FP).

This section describes the following Multiservice Switch node routing systems for Multiservice Switch trunks over ATM, including the PORS efficiency features:

DPRS on Multiservice Switch trunks over ATM

Nortel Networks Multiservice Switch Dynamic Packet Routing System (DPRS) is responsible for routing traffic such as frame relay, and DPN-100. The DPRS routing system does not differentiate between the routing behavior of frame-cell and Multiservice Switch trunks over ATM. However, the ability to route DPRS traffic on Multiservice Switch trunks over ATM provides significant advantages.

DPRS can quickly reroute around trunk failures when routing on Multiservice Switch trunks over ATM. This capability supports resilient frame relay connectivity with minimal administration. Multiservice Switch trunks over ATM also provide the ability to map many frame relay DLCIs into a single ATM virtual channel connection (VCC). This mapping simplifies the administration for ATM for frame relay services for each connection. DPRS on Multiservice Switch trunks over ATM provides the ability to use ATM to full advantage without significant impact to the existing network infrastructure. DPRS on Multiservice Switch trunks over ATM offers concentration of low-speed/high-density frame relay, and provides for rapid transfer with hardware forwarding and high speed Multiservice Switch trunks.

Multiservice Switch trunks over ATM carry DPRS traffic using AAL5 to convert frames to ATM cells. DPRS traffic routing can also be configured to run on spare equipment. See “Spared Multiservice Switch 15000 and Multiservice Switch 20000 Trunks over ATM” (page 184) for details.

PORS on Multiservice Switch trunks over ATM

This section describes the following Nortel Networks Multiservice Switch trunks over ATM information for PORS:

Multiservice Switch trunks over ATM carrying PORS traffic can also be configured to run on spare equipment. See "Spared Multiservice Switch 15000 and Multiservice Switch 20000 Trunks over ATM" (page 184) for details.

Multiservice Switch PORS ATM efficiency consists of the SPO-mux and map modes. This section includes additional PORS ATM efficiency information:

- "PORS traffic mapping to internal discard and emission priority" (page 173)
- "PORS ATM efficiency migration strategy" (page 177)
- "PORS ATM efficiency impacts" (page 178)
- "PORS ATM efficiency engineering guidelines" (page 178)
- "PORS ATM efficiency bandwidth guidelines" (page 179)
- "PORS ATM efficiency recommendations" (page 181)
- "PORS ATM efficiency known limitations" (page 181)
- "Multiservice Switch 7400 series node BTDS efficiency" (page 183)

PORS ATM efficiency

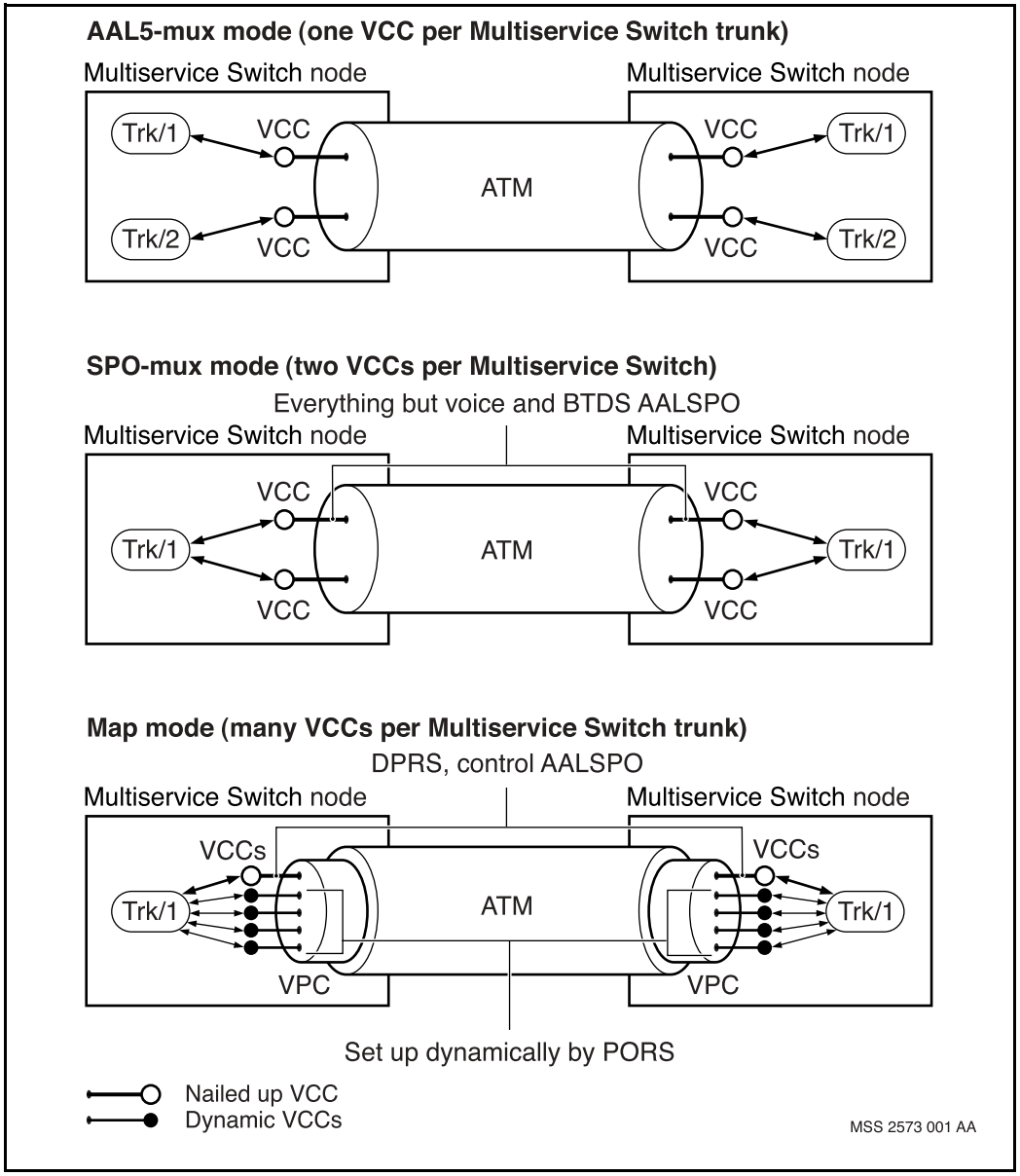
You can provision PORS applications such as voice and BTDS to optimize bandwidth on Nortel Networks Multiservice Switch trunks over ATM.

PORS ATM efficiency modes

You can provision PORS ATM efficiency using one of three transport capabilities or modes. See Figure 25, "Mapping Multiservice Switch trunks to ATM VCCs," (page 162) for a comparison of the three modes. The last two modes listed are in the PORS ATM efficiency category:

- "AAL5-mux mode" (page 164)
- "Short path-oriented multiplexing (SPO-mux) mode" (page 166)
- "Map mode" (page 169)

Figure 25
Mapping Multiservice Switch trunks to ATM VCCs



PORS ATM efficiency characteristics

PORS ATM efficiency has the following characteristics:

- increased throughput
- efficient transportation across frame-cell trunks and Multiservice Switch trunks over ATM
- supported on all ATM functional processors (FPs)
- supported for path-oriented services

PORS ATM efficiency adds to the existing bandwidth saving capabilities available on the voice service such as silence suppression and voice compression. For information on these capabilities, see NN10600-750 *Nortel Networks Multiservice Switch 7400 Operations: Voice Transport*.

See the Nortel Networks Multiservice Switch Release Notes for maximum throughput per ATM FPs and maximum VCCs.

Table 10
PORS ATM efficiency usage

Mode	# VCCs for each Multiservice Switch Trunk	ATM conversion method	When to use
AAL5-mux	1	AAL5	if little voice traffic and desire simplest administration
SPO-mux	2	AAL5 for PORS, DPRS data and control traffic; AALSPO for voice, BTDS traffic.	if voice traffic exists but map mode not appropriate
map	separate VCC for each call	AAL5 for DPRS and routing control traffic; AAL5 for PORS HTDS; AALSPO for voice and BTDS traffic.	if not limited by available VCC quantity if okay to have whole VPC through external ATM network

AAL5-mux mode

In this mode each Nortel Networks Multiservice Switch trunk links to a single ATM VCC, as Figure 26, "AAL5-mux mode," (page 165) illustrates. AAL5 encapsulation converts all traffic carried by the trunk to ATM cells.

AAL5 adds an eight-byte trailer, and 1 to 47 bytes of padding to each frame or Multiservice Switch cell to be converted to ATM cells. This method is inefficient for voice service since each voice cell (44-byte payload) ends up requiring two ATM cells (40 bytes of padding). BTDS can be defined to use Multiservice Switch cells with 84 bytes of payload. This method results in the Multiservice Switch BTDS cell fitting evenly in two ATM cells with no padding.

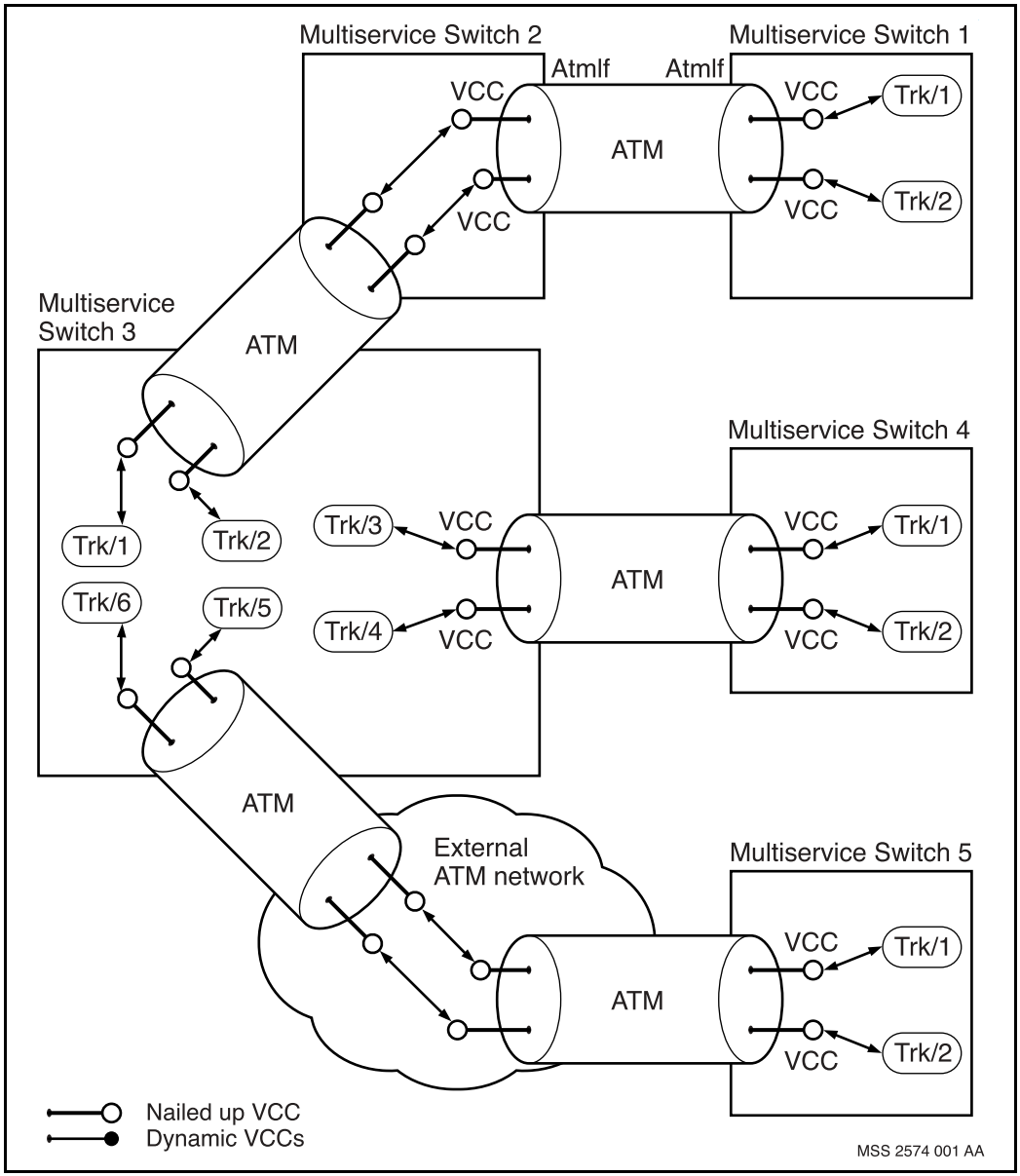
All connections between Multiservice Switch trunks and ATM VCCs are nailed up. These VCCs can be over a direct ATM connection between two Multiservice Switch nodes, or can pass through a tandem node or an external ATM network.

Depending on the service mix offered on the Multiservice Switch nodes, you can define one or more Multiservice Switch trunks, each to carry traffic requiring a different class of service. One of the Multiservice Switch trunks must be configured to carry frame traffic such as DPRS traffic and PORS HTDS traffic. The other must be defined to carry voice and BTDS traffic. The VCC for the Multiservice Switch trunk carrying voice and BTDS traffic must be defined with a QOS such as rt-VBR, which has a higher emission priority. This definition allows the voice and BTDS traffic to jump ahead of frame traffic to reduce the delay variance for the user data.

At tandem sites, where nailed up ATM VCCs carry Multiservice Switch trunks through the node, ATM cell relay forwards the traffic. Hardware performs the ATM cell relay and the relay is extremely fast.

At tandem sites where the ATM VCCs terminate at Multiservice Switch trunk components, the CPU performs the frame and cell forwarding. CPU forwarding throughput is considerably less than hardware-only forwarding for ATM cell relay.

Figure 26
AAL5-mux mode



Short path-oriented multiplexing (SPO-mux) mode

For the SPO-mux mode, you configure the Nortel Networks Multiservice Switch trunk to use two ATM VCCs, an AAL5-mux VCC, and a SPO-mux VCC, as shown in Figure 27, "SPO-mux mode," (page 167). The path administrator (Pa) adds and manages the new VCC.

The AAL5-mux VCC, usually called the parent VCC, uses AAL5 encapsulation to carry large frame PORS, DPRS data and control traffic. The SPO-mux VCC, uses AALSPO encapsulation to carry voice or BTDS cells, which are 45 bytes of payload or less.

The SPO-mux mechanism carries voice over ATM efficiently. These 45-byte frames plus a 3-byte PORS routing header, and a 5-byte ATM header are exactly 53 bytes, as shown in Figure 28, "Conversion of voice or BTDS packets into ATM cells using SPO-mux mode," (page 168). The 53-byte frames transport as pure cells (that is, no adaptation layer). The 45-byte payload results in 53 bytes on the link instead of 106 bytes when using the ATM adaptation layer 5 (AAL5) protocol.

To use SPO-mux mode transport, the applications must inform PORS that they are using frames no larger than 45 bytes. The maximum transmission unit (MTU) of the service and a new call flag to the VC sends this message to the PORS VC at call setup time.

Figure 27
SPO-mux mode

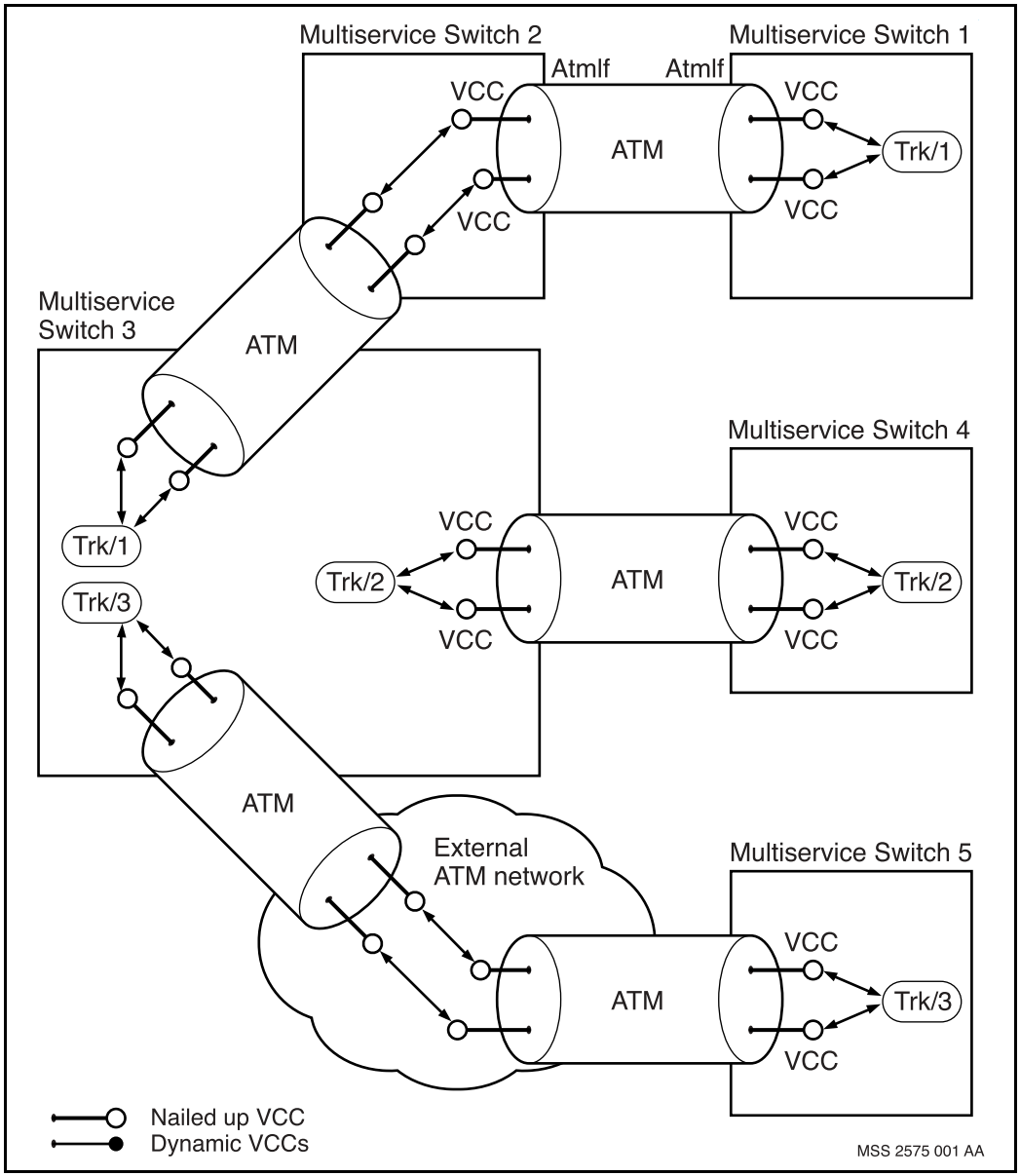
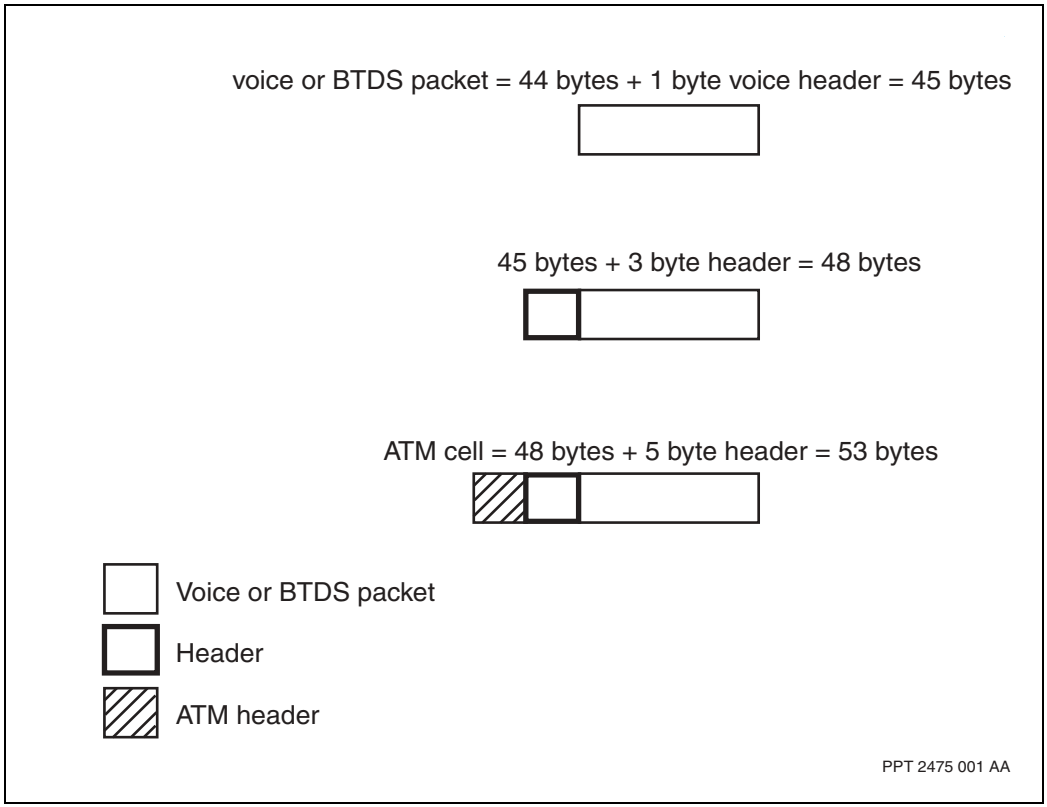


Figure 28
Conversion of voice or BTDS packets into ATM cells using SPO-mux mode



All connections between Multiservice Switch trunks and ATM VCCs are nailed up. These VCCs can be over a direct ATM connection between two Multiservice Switch nodes, or can pass through a tandem node or an external ATM network.

At tandem sites, where nailed up ATM VCCs carry Multiservice Switch trunks through the Multiservice Switch node, ATM cell relay forwards the traffic. Hardware performs the ATM cell relay and the relay is extremely fast.

At tandem sites where the ATM VCCs terminate at Multiservice Switch trunk components, the CPU performs the frame and cell forwarding. CPU forwarding throughput is considerably less than hardware-only forwarding for ATM cell relay.

Map mode

Map mode allows a much larger number of VCCs for each Nortel Networks Multiservice Switch trunk, as shown in Figure 29, "Map mode," (page 171):

- one AAL5-mux VCC to carry DPRS and routing control traffic using AAL5 encapsulation
- multiple AAL5-map VCCs to carry PORS HTDS and BTDS traffic using AAL5 encapsulation. For each HTDS or BTDS path, PORS sets up a separate ATM VCC, in the same VPC as the AAL5-mux VCC.
- multiple AALSPO-map VCCs to carry voice and BTDS traffic, using AALSPO encapsulation. For each voice and BTDS path, PORS sets up a separate ATM VCC, in the same VPC as the AAL5-mux VCC.

The AAL5-mux ATM VCC is nailed up. The AAL5-map VCCs and the ALSPO-map VCCs are dynamically created and managed by the PORS path administrator. Map mode trunks can be defined on direct ATM connections between two Multiservice Switch nodes. If you define map mode trunks over external ATM networks you must provision a whole VPC.

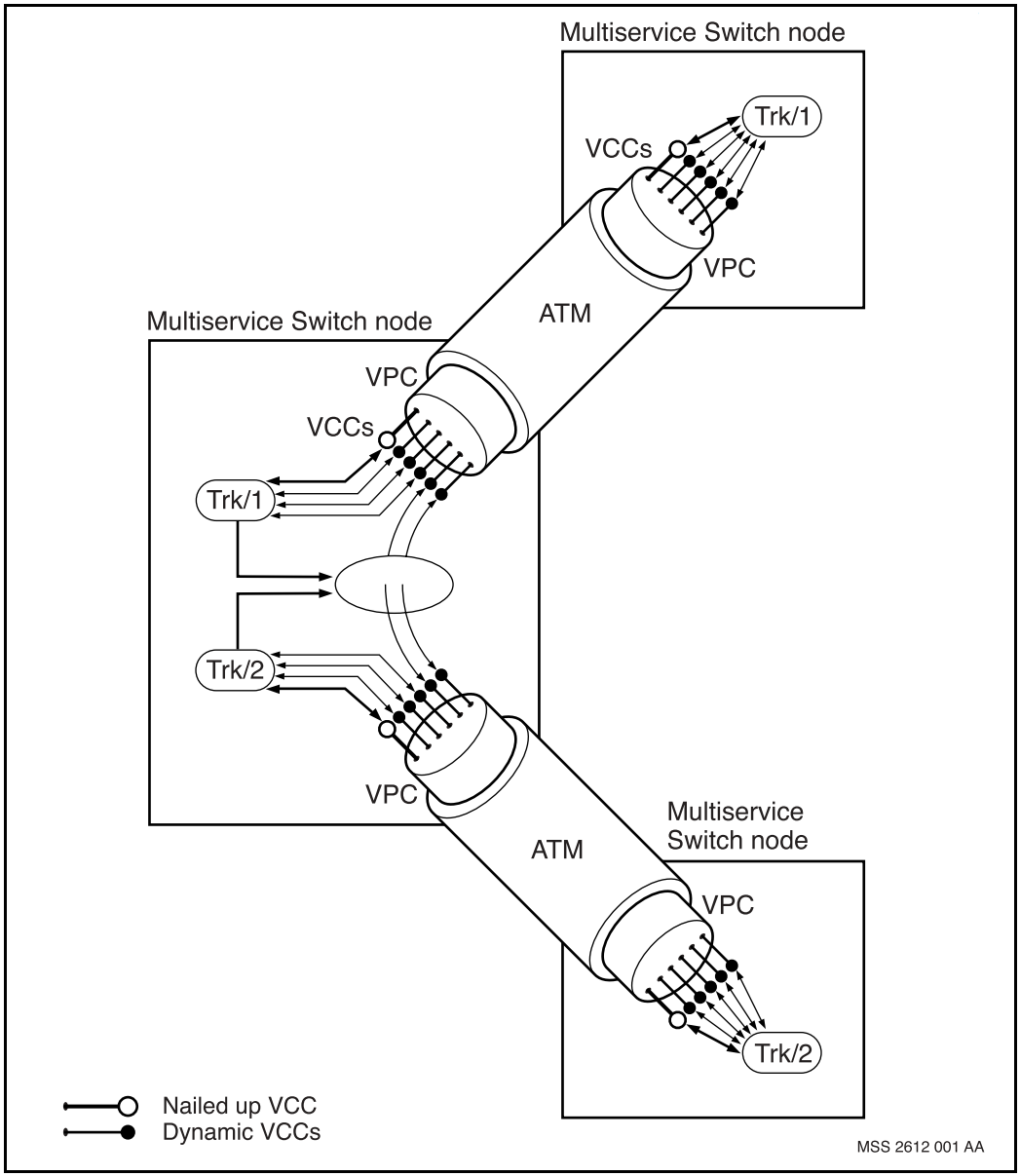
When a PORS path tandems through a Multiservice Switch node the PORS path administrator creates logical ATM relay points on the VCCs and connects them together for the duration of the time the path is up. These connections share the available connection address space with ATM SVCs, SPVCs and PVCs. This allows the PORS traffic to use ATM cell forwarding at the tandem nodes.

> ***Note:*** In order for PORS connections to establish on map mode trunks, the value of the *connectionPoolCapacity* attribute, under the *Lp Eng Arc Ov* component, must be set to a positive value. For details, see the Resource Management chapter of NN10600-710 *Nortel Networks Multiservice Switch 7400/15000/20000 ATM Configuration Management*.

DPRS and control traffic must use CPU forwarding at the tandem sites. This is because the traffic is multiplexed onto a single ATM VCC and the CPU is required to demultiplex it and make forwarding decisions.

All the map VCCs are created in the same VPC where the AAL5-mux ATM VCC is defined.

Figure 29
Map mode



Map mode introduces three new kinds of mapping:

- AAL5-map
- AALSPO-map
- cell-map

The following sections detail map mode:

- "Role of the path administrator in map mode" (page 172)
- "Selecting the map mode type" (page 172)

Role of the path administrator in map mode

You can use all three kinds of mapping at the same time under the same *Pa* component depending on the circumstances at call setup. When provisioned for map mode, the *Pa* component maps all calls to individual VCCs. In this mode, the provisioned Multiservice Switch trunk over ATM AAL5 VCC only carries PORS and other routing control traffic and never PORS data.

Selecting the map mode type

The selection of the map mode depends on the following:

- voice or BTDS, or other application
- to what type of link or service you are forwarding data

A voice or BTDS service triggers the use of AALSPO-map at all frame or cell boundaries along the path (that is, everywhere that conversions from frame to cell are necessary such as endpoints or tandem hops from or to frame-based FPs). Other services trigger the use of AAL5-map at all frame or cell boundaries along the path.

At cell-to-cell boundaries along the path, pure cell mapping occurs regardless of the MTU. It is the use of cell relay at tandem points that reduces the end-to-end delay since segmentation and reassembly does not occur at these tandem points.

> ***Note:*** Cell relay is only possible to another *Pa* component in mapped mode. Otherwise, cell or frame conversions occur by hardware at this boundary using the appropriate AAL5-map or AALSPO-map protocol.

PORS traffic mapping to internal discard and emission priority

In map mode, PORS can specify the traffic mapping for traffic on mapped ATM VCCs. The PORS PLC emission and discard priority provisionable attributes specify the ATM QoS for these ATM VCCs.

Traffic mapping depends on the traffic flow direction (from the link or toward the link) and the traffic type (frame or cell relay traffic). This section describes the following information:

- "Receive mapping—cell relay" (page 173)
- "Receive mapping—frame" (page 174)
- "Transmit mapping—cell relay" (page 175)
- "Transmit mapping—frame" (page 176)

Receive mapping—cell relay

For traffic received from an ATM link, the cell loss priority (CLP) value from the ATM cell header and the PORS PLC discard priority for the connection determine the internal discard priorities of each cell. Once the FP receives a cell from the link, it compares the cell's internal discard priority with the memory congestion state. If the discard priority is greater than the memory congestion status, the FP discards the cell. If the discard priority is less than the memory congestion status, the FP allocates memory for the cell. See Table 11, "Receive mapping: queue selections based on mapping conversions," (page 174), for a summary of mapping queue selections.

Next, the cell joins the appropriate bus queue. Before queueing the cell, the FP compares the cell's internal discard priority value with the bus congestion state. The FP discards the cell if its discard priority value is greater than the bus congestion state. The PLC emission priority determines the bus emission priority. See Table 12, "Receive mapping: PORS PLC emission priority to bus emission priority," (page 174), for a summary of the receive mapping to bus emission priority.

Table 11
Receive mapping: queue selections based on mapping conversions

Mapping mode	Queue
AAL5-map to AAL5-mux	bus
AAL5-map to frame	bus
AAL5-map to AALSPO-mux	processor
AALSPO-map to AAL5-mux	bus
AALSPO-map to frame	bus
AALSPO-map to AALSPO-mux	processor

Table 12
Receive mapping: PORS PLC emission priority to bus emission priority

PLC emission priority	Bus emission priority
0	high
1	normal
2	normal

Receive mapping—frame

For traffic received from an ATM link, the CLP value from the ATM cell header and the PLC discard priority (of the service associated with the ATM VCC) determine the internal discard priorities of each cell.

As with receive mapping for cell relay, once the FP receives a cell from the link, it compares the cell's internal discard priority with the value for the memory congestion state. If the discard priority is greater than the memory congestion status, the FP discards the cell along with any other cells belonging to the same frame.

Once the frame has been reassembled from ATM cells, the frame can directly join a processor queue or a bus queue. See Table 11, “Receive mapping: queue selections based on mapping conversions,” (page 174), for a summary of mapping queue selections.

The transporting cell's CLP and the PLC discard priority determine the frame's discard priority. Before queuing the frame, the FP compares the frame's internal discard priority value with the processor or bus congestion state depending on which destination queue is selected. The FP discards the frame if its discard priority is greater than the queue's congestion state.

See Table 13, “Receive mapping: PLC discard priority and CLP to (internal) discard priority,” (page 175), for a summary of receive mapping to internal discard priorities. For AAL5, the frame CLP (internal) is set to 1 if the CLP in any of the constituent ATM cells is equal to 1.

Table 13
Receive mapping: PLC discard priority and CLP to (internal) discard priority

PLC discard priority	CLP	Discard priority
0	0	internal control (0)
1	0	very important (1)
	1	least important (3)
2	0	important (2)
	1	least important (3)
3	0	least important (3)
	1	least important (3)

Transmit mapping—cell relay

For ATM cell relay traffic, the cell's CLP and the PLC discard priority determines the discard priority. See Table 14, “Transmit mapping: PLC discard priority and CLP to (internal) discard priority,” (page 176). The discard policy uses the discard priority when the cell demands resources that are congested (such as, link and memory).

The CLP value is the same for ATM cell relay traffic in the transmit direction.

For transmitted cells, the emission priority selects one of the three link emission priority queues. The PORS PLC emission priority determines the emission priority. See Table 15, "Transmit mapping: PORS PLC emission priority to link emission priority," (page 176), for a summary.

Table 14
Transmit mapping: PLC discard priority and CLP to (internal) discard priority

PLC discard priority	CLP	Discard priority
0	0	internal control (0)
1	0	very important (1)
	1	least important (3)
2	0	important (2)
	1	least important (3)
3	0	least important (3)
	1	least important (3)

Table 15
Transmit mapping: PORS PLC emission priority to link emission priority

PLC emission priority	Link emission priority
0	high
1	medium
2	low

Transmit mapping—frame

For frames in the transmit direction, the emission priority selects one of the three link emission transmit priority queues. The PORS PLC emission priority attribute, as provisioned for the service associated with the ATM connection to which the frame is forwarded for processing, determines the emission priority. See Table 15, "Transmit mapping: PORS PLC emission priority to link emission priority," (page 176), for a summary of transmit mapping.

The internal discard priority is already set when the FP receives the frame from the bus. The discard policy uses the internal discard priority when demand for the resources (link and memory) exceeds capacity. The frame's priority determines the internal discard priority. The discard priority of the frame determines the CLP value of the cells comprising the AAL5 frame. See Table 16, "Transmit mapping: discard priority to CLP (for AAL5 frames)," (page 177), for a summary of the discard priority to CLP.

Table 16
Transmit mapping: discard priority to CLP (for AAL5 frames)

Discard priority	CLP
0	0
1	0
2	0
3	1

PORS ATM efficiency migration strategy

You do not have to provision both ends of the trunk simultaneously since the PORS ATM efficiency feature reverts back to routing over the AAL5 VCC unless both ends are properly provisioned. The *Pa* component detects the difference in provisioning and issues the following warning message:

```
MSG warning operator configurationError 7018009

Com: my atmConnection is not responding or is not
connected to same peer PA as my parent trunk's
atmConnection.

Calls requesting it will default to AAL5 over parent
trunk.
```

It then defaults back to its original behavior until you provision the far-end *Pa* component to use this feature.

If the neighbor *Pa* component is running the proper version of software, it also detects that its peer wants to perform SPO-mux mode routing. If it has not been provisioned for this feature yet, it issues the following warning message and reverts to the default behavior, just like its peer:

```
MSG warning operator configurationError 70180010

Com: Neighbor not provisioned for mapped mode routing
but I am.

Calls requesting it will default to AAL5 over parent
trunk.
```

There is a shorter trunk outage if you reprovision both ends simultaneously.

PORS ATM efficiency impacts

The PORS ATM efficiency feature has no impacts on existing Nortel Networks Multiservice Switch node features and there is no difference in voice quality.

There are performance costs associated with running a network where some nodes support the PORS ATM efficiency feature and some do not.

If any nodes along the path are not provisioned with the PORS ATM efficiency feature, the routing system has to disable the feature on the nodes which have this feature provisioned. This disabling process causes additional overhead activity on the routing system. In order to avoid this scenario, all nodes along the path must have the feature provisioned.

PORS ATM efficiency engineering guidelines

The ATM FP (regardless of interface type) can run at a particular sustained rate (packet/s). At the sustained rate, CPU utilization is close to 100%. Nortel Networks Multiservice Switch node FPs must be subjected to less than 90% sustained CPU utilization, including short bursts of up to 90% in either direction (on the order of several seconds). Sustained bursts results in data loss and possibly control frame loss on the FP. This loss causes an FP's trunk to oscillate up and down every few minutes.

Operating outside of these guidelines can result in the loss of small amounts of data whenever control traffic is present. For example, the voice service can experience clicks and pops when you issue display commands on an overly busy FP.

Note: The ATM bearer services do not require CPU intervention for forwarding on ATM FPs. This CPU utilization limit applies only to PORS or connectionless packets requiring CPU intervention for forwarding.

PORS ATM efficiency bandwidth guidelines

You require the AAL5-mux VCC's bandwidth and the reserved PORS bandwidth to determine the amount of available PORS bandwidth for the SPO-mux mode trunk. The defined PCR for the Nortel Networks Multiservice Switch trunk determines the AAL5-mux VCC bandwidth. The PA uses the calculated PORS bandwidth to decide if a connection may or may not be admitted. The PA never looks at the SPO-mux VCC's bandwidth for this decision.

From a routing perspective, all bandwidth must be represented by a single number for a given PA. This requires special consideration when you decide how to allocate bandwidth to the SPO-mux VCC. Here are some bandwidth strategies for various scenarios (see Figure 30, "ATM efficiency bandwidth guidelines," (page 180)):

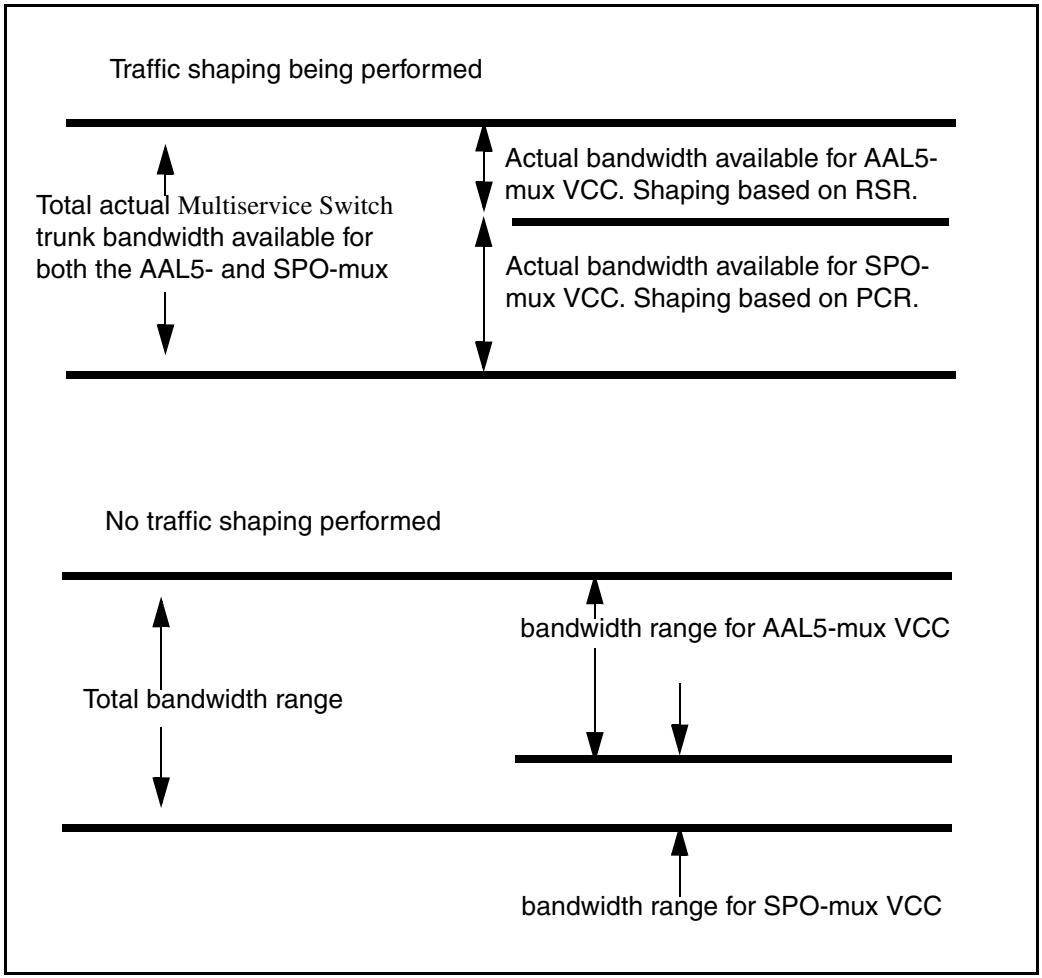
- Shaping of AAL5-mux and SPO-mux VCCs

  When you set up policing for the Multiservice Switch trunk over ATM VCCs, you must also shape the individual VCCs. For the AAL5-mux VCC, the PCR value must consider the total reservable bandwidth requirements for PORS and DPRS traffic. The requested shaping rate and the amount of traffic that will be carried over this connection determines the AAL5-mux VCC shaping rate. Typically the total Multiservice Switch trunk bandwidth minus the PCR of the SPO-mux is the AAL5-mux VCC shaping rate. The SPO-mux VCC shaping rate must consider the sum of the PORS traffic that will be carried by this connection.

- No policing or shaping of AAL5-mux and SPO-mux VCCs

  For the SPO-mux VCC, assign the PCR value to 0 cell/s or another low value. Assign the PCR of the AAL5-mux VCC to account for all remaining Multiservice Switch trunk bandwidth. This approach avoids over reserving connection bandwidth from the ATM bandwidth pool.

Figure 30
ATM efficiency bandwidth guidelines



PORS ATM efficiency recommendations

Use the following guidelines to set up the PORS ATM efficiency feature:

- Set up the bandwidth for the two VCCs as outlined in "PORS ATM efficiency bandwidth guidelines" (page 179).
- Set the *endToEndloopback* attribute to on. This setting provides a software continuity check to ensure that the VCC that is linked to the *Pa* component is connected to its proper destination. See "Provisioning map mode" (page 58).
- Provision the feature on all the nodes along the path. See "PORS ATM efficiency impacts" (page 178) for more information.

PORS ATM efficiency known limitations

The following sections describe the limitations of this feature:

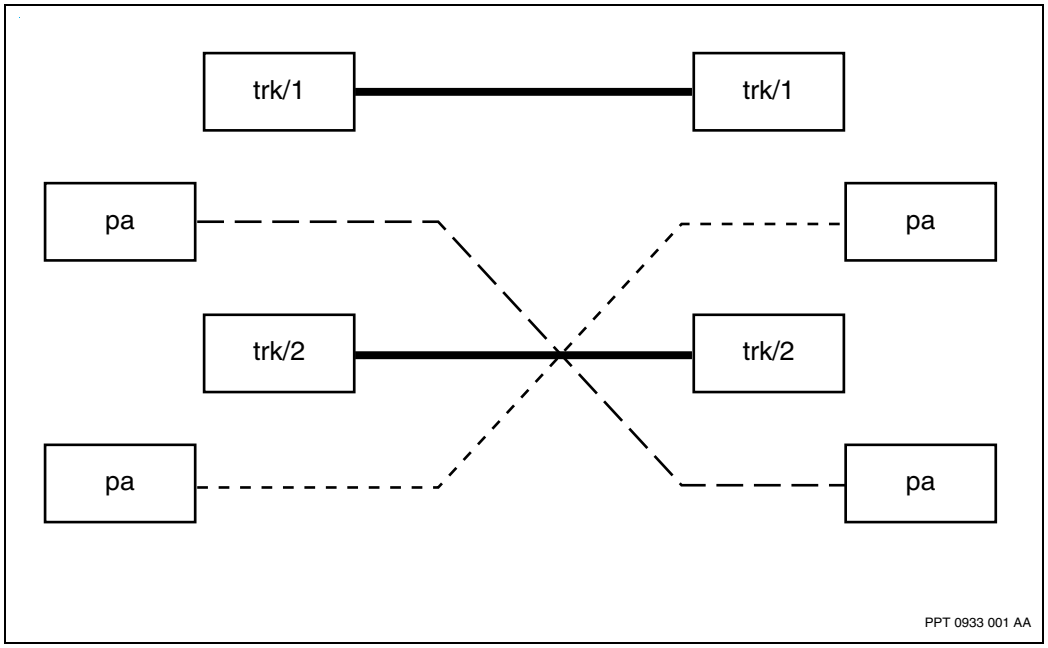
- "When a PA VCC is not connected to the same place as Multiservice Switch trunk VCC" (page 181)
- "PA VCC must be provisioned for endToEndLoopback" (page 182)
- "No integrity checking on voice calls" (page 183)
- "Allocating static VCCs over dynamic VCCs" (page 183)

When a PA VCC is not connected to the same place as Multiservice Switch trunk VCC

If the VCC that is linked to the PA is not connected to the proper destination, there is no detection or alarm for this situation and circuits fail to operate. In Figure 31, "Trunks (trk/1 and trk/2) with cross-connected PAs," (page 182), two trunks PAs are accidently cross-connected. The calls complete but do not carry data. In addition, queries to the logical channel (LC) of a voice service which uses the PA's VCC results in time-outs in the round trip delay that causes the call to be torn down and re-established over the same facility. Until integrity and connectivity checks are available on the second circuit, careful engineering is necessary to avoid this problem.

Route the PA's VCC and the Nortel Networks Multiservice Switch trunk's VCC identically whenever possible to avoid this limitation.

Figure 31
Trunks (trk/1 and trk/2) with cross-connected PAs



PA VCC must be provisioned for endToEndLoopback

The only continuity check made on the PA's VCC is by the VCC itself using the endToEndLoopback option of the VCD. While this software detects a break in the VCC, it takes over 30 seconds which for most voice calls is too long. The trunk's VCC has internal software that detects a break in approximately six seconds. There is no equivalent software in the PA which can do continuity checks with higher precision. For this reason, it is best to route the trunk's VCC and the PA's VCC over the same physical facilities whenever possible. This solution ensures that a breach to one breaches the other and that continuity problems on the PA's VCC do not go undetected for too long. It is also best to share the physical resources for the two VCCs for bandwidth sharing reasons. See "When a PA VCC is not connected to the same place as Multiservice Switch trunk VCC" (page 181).

No integrity checking on voice calls

There is no room in the voice packets for LRC or CRC bytes. A voice packet can be corrupted when it traverses an ATM link without being detected. For the voice service, you can get a corrupt sample instead of a completely missing cell.

Allocating static VCCs over dynamic VCCs

When PORS dynamically uses a VCC with this feature, it reserves the VCC as a PORS VCC. When you provision a static VCC in this space, it does not come up since it is an invalid VCC. When PORS is done with the VCC, it releases the VCC. The static VCC does not come up until activation of the AtmIf takes place. (When PORS releases the connection, the ATM software does not check for the released VCC.) At present, the only way for ATM software to realize that the connection has been released, is to activate a provisioning change on the *AtmIf* component.

To avoid this limitation, do not provision static VCCs over dynamic VCCs.

Multiservice Switch 7400 series node BTDS efficiency

You can provision BTDS to optimize bandwidth on Nortel Networks Multiservice Switch trunks over ATM for Multiservice Switch 7400 series nodes. You can provision the larger cell size to take advantage of the AAL5 transport mode on FPs that support AAL5, or the smaller cell size for the SPO-mux mode. A larger BTDS cell size provides the following benefits:

- increased BTDS throughput
- efficient transportation across frame-cell trunks and Multiservice Switch trunks over ATM

The smaller cell size provides the benefits of SPO-mux mode.

For details on the BTDS efficiency feature, see NN10600-775 *Nortel Networks Multiservice Switch 7400 Operations: Bit Transparent Data Service*. For information on which FPs support AAL5, refer to NN10600-551 *Nortel Networks Multiservice Switch 7400/15000/20000 FP Configuration Reference*.

Spared Multiservice Switch 15000 and Multiservice Switch 20000 Trunks over ATM

Nortel Networks Multiservice Switch 15000 and Multiservice Switch 20000 node trunks over ATM can be provisioned on a spared LP as warm standby features. A warm standby application or feature can operate together with a hot standby application or feature on the same FP without affecting the ability of the hot standby application or feature to provide hitless services. See NN10600-550 *Nortel Networks Multiservice Switch 7400/15000/20000 Common Configuration Procedures* for a description of hitless services and hot, warm and cold standby applications and features.

Although Multiservice Switch trunks over ATM can be provisioned as warm standby features, DPRS and PORS routing is interrupted during an equipment switchover. DPRS and PORS routing becomes available after:

- the switchover to the standby FP is complete
- Multiservice Switch trunks over ATM are re-established

Nortel Networks Multiservice Switch 7400/15000/20000

Operations: Trunking

Release 6.1

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